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CORRESPONDENCE.

On Defining the Degree of Curve: Comments Suggested by Review of Raymond's Field Geometry and Subsequent Correspondence.

Sir: "Progress" in his comments on Mr. F. Lavis' review of Prof. Raymond's "Field Geometry," asks:

what author or authors ever before offered this 100-ft.-arc definition? Where can such a book with the necessary tables be found?

To these questions Mr. Lavis replies:

I do not know of any author who uses the angle subtended by the arc in defining the degree of curve; I do not know of any book of tables, nor do I know of any road in North America where this principle has been adopted. . . .

The writer, during a number of years spent in railroad location, both in this country and Mexico, acquired some interesting experiences; not the least of which, as he now recalls, occurred while he was an assistant engineer on the Kansas City, Watkins & Gulf Ry., under Prof. P. H. Philbrick, its then Chief Engineer. This gentleman had been educated at the University of Michigan, served some time as Professor of Civil Engineering at the University of Iowa, and afterwards went South as Chief Engineer of the above-named road, and of the North American Land & Timber Co., an affiliated concern. He was the most agile arithmetician the writer ever encountered, an excellent woodsman and field engineer, and with his extensive knowledge of scientific matters and a vast fund of literary learning was a most interesting character.

In 1901 Prof. Philbrick published, from the house of John Wiley & Sons, a hand-book called "Field Manual for Engineers." The book contained some unique features and radical departures from other similar publications, which the present writer remembers the more clearly, perhaps, for the reason that he helped the Professor in the preparation of the manuscript. Some of the unique features the present writer considered superior to current practice, while of others so much could not be said. In view of man's mental inertia, it is no wonder the book never won popularity, but nevertheless it is well worth the study of young men engaged in field work.

Coming finally to the point, on page 42 of this book the degree of curve is defined as

the change in its direction between one point and another 100 ft. from the first measured on the curve . . . or as the angle subtended at the center of the curve by an arc 100 ft. in length.

On the pages following, this point is emphasized and discussed at considerable length, especially the matter of the errors in work based upon the different systems. Further, in the collection of tables, which as usual forms a part of the book, the table of radii is based upon the arc principle and is worked out as fully as similar tables in other works.

Apparently it is generally admitted that the arc-measurement system is the more desirable, while the most that can be said of the system now in vogue is that it is "best current practice," and that it would be "some trouble to make a change." The fact is, however, that it is common practice for engineers to use the arc definition in their field computations, as is admitted by Prof. Nagle in his excellent "Field Manual," page 41, in which book, however, the values given in the table of radii, to conform to current practice, are juggled to fit the chord-unit idea. (For example, there are two different values given for the radius of a 7° curve, namely, 818.64 and 819.02 ft., surely not a very admirable practice, even if generally adopted.)

Present practice in railroad field work shows clearly the dominating influence of the work of Mr. J. B. Henck. The writer thinks, however, that it is to be regretted that the profession has not rather followed the suggestions of Mr. S. C. Cross, an engineer contemporaneous with Mr. Henck, and whose fragmentary "Field Book" was issued about 1854 (?) In this work the definition of terms and the method for laying out circular curves, are, it is believed, superior to those advocated by Mr. Henck. In this work the degree of curve is given as the "number of degrees per 100 ft.," and with more clearness we are told that "to determine the degree of curve having the radius given, divide the radius of a 1° curve, 5,730, by the radius of the given curve," which is equivalent to the arc definition. Mr. Henck, with the clearness and conciseness which characterized his work, defined the degree of curve (edition of 1860) in these words: "The degree of curve is determined by the angle subtended at its center by a chord of 100 ft.," and this definition, with the resulting inconsistencies, has tarried with us to this day.

Erdis Robinson, M. Am. Soc. C. E.

515 West First Ave., Columbus, Ohio, Jan. 31, 1911.

Sir: Referring to correspondence in Engineering Literature Supplement for Jan. 19, 1911, from Mr. F. Lavis and "Progress," concerning 100-ft.-arc method of defining degree of curves:

For the information of both correspondents, as well as other readers of Engineering News, I wish to state that at least two field-books for engineers have been published in which "Degree of Curve" is defined as the angle at the center, subtended by 100 ft. of arc," or in words to that effect. The two books referred to are "Curves of Civil Engineering," written and published by Arthur M. Haynes, Member Western Society Engineers, Denver, Colo., and Philbrick's "Field Manual for Engineers," published by John Wiley & Sons, New York. The first book contains a table of "Tangent Distances, Long Chords and External Secants for a One-Degree Curve" (100-ft. arc method) for central angles between 0° and 108° varying by 2' intervals. It also contains a table of "Differences in Lengths of Arcs and Corresponding Chords" for various lengths of arc for the list of curves of various degrees. I send a copy of this table as it will show one of the advantages of the 100-ft. arc method of calculating and staking out curves for railroads, streets, canals, etc.

I have no copy of Philbrick's book at hand and cannot state what tables it contains, but I am sure that it contains a table of radii calculated by the 100-ft. arc method; and probably it has a table of functions of a 1° curve, similar to Mr. Haynes' table.

Both of the above-mentioned authors claim as one advantage for their method, that all sorts of "corrections" and various schemes used in field work to make a curve "check out" are done away with, when correct calculations are used and careful field work is done. With the 100-ft. chord method of defining and calculating curves, correct results are obtained only when 100-ft. chords are used. If 50-ft. chords are used with that method a correction must be applied to the length of the 50-ft. chords* if satisfactory results are to obtained. For example to run a 14° curve with 50-ft. chords, the chords should be measured 50.093 ft. each. Similar corrections must be made if other lengths of chords are used. One author of an engineers' pocket-book avoids the "correction" evil by stating that "for curves up to 7°, 100-ft. chords may be used; from 7° to 14°, 50-ft. chords may be used and for curves from 14° to 28°, we should use 25-ft. chords. Over 28° shorter chords—say 10-ft., should be used"; and he furnishes a table of Radii calculated according to his recommended lengths of chords.† When the 100-ft. chord method is used, "corrections" must also be applied to the lengths of "sub-chords" at the ends of curves; and to the lengths of Tangent Distances, Long Chords, Externals, etc., if obtained by the use of a table of functions of a 1° curve.

Now in the use of the 100-ft.-arc method the proper length of chord for various lengths of arc is taken from a table direct and used without any correction, as it is already mathematically correct, as stated in the table. The *length of arc is known but not used or actually measured* IN THE FIELD, as many persons seem to believe is part of this method. The only use made of the length of arc is in calculating the length of the curve (which with this method is exactly known and not approximated). With this method one may use any length of chord desired, viz., for a 10° curve he may use two 49.87-ft. chords or five 19.999-ft. chords to stake out 100 ft. of arc, without recalculating the radius of the curve, the tangent distance, etc., and without any correction. If the 100-ft.-chord method is used corrections must be applied to the 50-ft. chords, or else the radius and tangent distances must be recalculated, making the ordinary tables for curves of no value in such a case (except Nagle's). Again with the 100-ft. arc method all the radii are proportional and by using the table of functions of a 1° curve that are calculated for this method, one can obtain the tangent distance for a curve of any degree or for a curve of any radius (by converting it into degrees by the simple formula

$$\frac{5729.578}{\text{Radius}} = \text{degree of curve, expressed decimally).}$$

This means that an engineer applies the same formulas and rules to work out a simple curve problem in narrow-gage railroad, street, canal or any other kind of work that he does to a high-speed, standard-gage railroad. One book and one set of tables answers for all simple curve problems. The writer has found in his practice that many high-speed railroads require (and properly so) that center stakes be set every 50 ft. (sometimes even on construction work) on light curves, and every 25 ft. on sharp curves. Elevated tracks, tunnels, subways, bridges and important buildings and platforms make it necessary to "split hairs" on some curves of nearly all railroads, and at such places corrections and "scheming" or "fudging" the curve in, so it will check on P. T. or other previously-established point, will not do and correct work is properly insisted upon.

It is just as easy to use two 49.87-ft. chords to stake out 100 ft. of 10° arc, as it is to use two 50.05-ft. chords to stake out a 100-ft. chord on a 10° curve, yet this is

*See Searle's "Field Engineering," Arts. 106 and 107, Chap. V., pages 55 and 56 of 16th edition; and Webb's "Railroad Construction," latter part of Art. 19, Chap. II., concerning lengths of chords and sub-chords.

†See Nagle's "Field Manual for Railroad Engineers."

DIFFERENCES IN LENGTHS OF ARC AND CORRESPONDING CHORDS, AS GIVEN IN HAYNES' "CURVES OF CIVIL ENGINEERING."

Degree of curve.	Radius of curve.	Lengths of Arc. 100	90	80	70	60	50	40	30	20	10
1°	5,729.58	.001	.001	.001	.001	....	....	....	....	....	....
2°	2,864.79	.005	.004	.003	.002	.001	....	....	....	....	....
3°	1,909.86	.011	.009	.006	.004	.002	.001	....	....	....	....
4°	1,432.40	.020	.015	.010	.007	.004	.002	.001	....	....	....
5°	1,145.92	.031	.023	.016	.011	.007	.004	.002	....	....	....
6°	954.93	.045	.033	.023	.015	.010	.006	.003	.001	....	....
7°	818.51	.062	.045	.031	.021	.013	.008	.004	.002	....	....
8°	716.20	.081	.059	.041	.028	.017	.010	.005	.002	....	....
9°	636.62	.103	.075	.053	.036	.022	.013	.006	.003	....	....
10°	572.96	.127	.093	.065	.044	.027	.016	.008	.003	.001	....
11°	520.87	.154	.113	.079	.053	.033	.019	.010	.004	.001	....
12°	477.46	.184	.134	.094	.063	.040	.022	.012	.005	.001	....
13°	440.74	.216	.158	.110	.074	.046	.027	.014	.006	.002	....
14°	409.25	.250	.183	.127	.086	.054	.032	.016	.007	.002	....
15°	381.98	.286	.209	.146	.099	.062	.036	.018	.008	.002	....
16°	358.10	.324	.236	.166	.112	.070	.041	.021	.009	.003	....
17°	337.02	.365	.266	.187	.126	.079	.046	.023	.010	.003	....
18°	318.31	.409	.298	.209	.141	.088	.051	.026	.011	.003	....
19°	301.56	.456	.333	.233	.157	.098	.057	.029	.012	.004	....
20°	286.48	.507	.370	.259	.174	.109	.064	.032	.014	.004	....
25°	229.18	.792	.580	.407	.273	.172	.099	.051	.021	.006	....
30°	190.99	1.136	.830	.580	.390	.245	.142	.072	.031	.009	.001
40°	143.24	2.018	1.480	1.036	.695	.435	.252	.130	.054	.016	.002
50°	114.59	3.144	2.270	1.600	1.086	.686	.393	.200	.085	.025	.003
60°	95.49	4.507	3.300	2.310	1.550	.970	.564	.290	.121	.036	.004
100°	57.2958	12.218	....	....	....	....	....	....	....	....	....
180°	31.83	36.3	....	....	....	....	....	....	....	....	....

all the difference in field work in the two methods. In the calculation of curves, the 100-ft.-arc method "puts it all over" the 100-ft.-chord method, and no approximations or corrections are used either. The article by Mr. W. H. Wilms on "Readjustment of Curves and Tangents, etc.," published in Engineering News, Sept. 17, 1908, brings out the question of accuracy in such work. He states that

not a few instrument-men compute the radii of all curves up to 14° or 15° by the two 50-ft.-chord definition ($R = 25 \div \sin \frac{1}{4} D$) and the entire curve is then run in with 50-ft. chords. The writer, Mr. Wilms, uses this method and finds that it gives excellent results. The Southern Pacific Ry. uses radii computed to 50-ft. chords exclusively; this is not only on maintenance work, but on location and construction work also.

Compare the amount of work necessary to compute such radii and the amount of work necessary to look into a table and obtain the correct lengths of two or more chords to use to stake out 100 ft. of arc. Then after the radii are computed, if tangent distances are needed, those instrumentmen would have to calculate it by formula $T = R \times tan \frac{1}{2} I$. With the 100-ft. arc system they would divide T for 1° curve by degree of curve for the proper I and get the correct T.

I have gone into detail in this description of the 100-ft.-arc method of calculating and staking out curves for three reasons: (1) because I believe it is generally misunderstood; (2) because books of tables are printed for its use, and it can be made standard (or legalized) on a railroad without any serious change in existing curves when occasion may require them to be rerun; and (3) because it applies with equal correctness to curves of all radii, being itself geometrically correct. A chief engineer beginning location or construction of a railroad, or in charge of maintenance-of-way on a road where it is proposed to rerun and monument the curves, might secure better results and uniformity of work by making this method standard on his road; and avoid the "correction" methods and "fudging in" schemes which are almost as numerous as transitmen. Engineering News for March 26, 1908, (page 347) presents a very complete set of simple curve formulas prepared by Mr. J. Calvin Locke, which are correct for the use of the 100-ft.-arc method.

The main arguments in favor of the 100-ft.-chord method are (1) that for approximate work it is simpler in the field, as chainmen would not have to bother with the decimal part of a foot, using only even lengths of the tape, etc.; (2) that most engineers' pocket-books or field-manuals are written on that method and practically all engineers have learned that method; and (3) some railroads have gone to great expense to stake out their curves by that method, monument them and record the notes for future work. Although the American Railway Engineering and Maintenance of Way Association has, I believe, adopted the 100-ft.-chord method as recommended practice, I doubt if the question is finally settled, as no doubt there are many other engineers that have had the same amount of extra calculations, etc., to go through with in using the 100-ft.-chord method, that I have had in doing work so as to secure good results in staking out curves.

Yours truly,

David W. Stradling,

Assistant Engineer, City of Indianapolis.

Indianapolis, Ind., Jan. 24, 1911.

[Proof of these two letters having been submitted to Mr. Lavis, the author of the review which gave rise to this correspondence, he responded briefly as printed below.—Ed.]

Sir: The letters of Messrs. Robinson and Stradling are interesting and simply confirm my statement that the idea of basing the definition of degree of curve on 100-ft. arcs, rather than chords of that length, is by no means new. It hardly seems necessary, however, to go into any extended discussion to show that it is neither "man's mental inertia" or necessarily "established custom" which causes railroad engineers to prefer the chord. There is no basis in fact for the idea that curves cannot be laid out *absolutely accurately* when the radius is based on the angle subtended by the chord and, if absolute accuracy is required, with even less work than when the radius is based on the length of the arc.

F. Lavis.

50 Church St., New York City, Feb. 9, 1911.

Suggested Improvement in Engineering Hand-Books.

Sir: The recent advent of a new Civil Engineer's Hand Book, a volume which appears to be a thoroughly up-to-date publication, whatever the defects in a first edition may be found to be after the microscopical scrutiny it will soon be compelled to undergo, make one wonder why an edition printed on India paper would not be practicable. It seems a pity that there should not be in this country a single mill where India paper is turned out—there are said to be two in England. I would predict a large demand, as demand for scientific or technical books go, for the first complete hand-book using such paper. The new hand-book contains about 1,300 pages and is very nearly 1½ ins. thick. A copy of "Vanity Fair," on India paper, containing 784 pages is, without covers, .53-in. thick. Thus the 1,300-page hand-book would be .86-in. thick, a consummation devoutly to be wished. There may be some reason, such as difficulty with printing line cuts on such thin paper, which would render the change impracticable, but if possible it would be a real *hand*-book, and not one requiring a bag for transportation.

Truly yours,

Frederic I. Winslow,

Librarian, Boston Society of Civil Engineers.

Boston, Mass., Jan. 21, 1911.

[It would be a boon to engineers if publishers of technical books would always use as thin and as light a paper as is consistent with general serviceability. Shelf space and economy of both space and weight in moving one's books from place to place would thus be gained. The saving in postage would sometimes more than offset and would always reduce somewhat the extra cost incurred by the publisher in using thinner and better paper.—Ed.]

A Convenient Method of Indexing and Filing Current Engineering Literature.

Sir: The discussion between your correspondents over the relative merits of "clipping" and "indexing" technical journal data is of interest to all engineers, as experience has taught every one that the bound volumes of technical journals do not yield their maximum efficiency as reference files. It may therefore interest some to know of a system which combines the advantages of clipping and simple indexing and which has proven quite successful in practice.

Upon the arrival of each journal it is scanned and all material worth keeping is marked. The Journal is then cut down to minimum size by removing all unmarked sheets and the remainder bound into a unit with paper fasteners.

These units are each given a number and are filed in boxes in numerical order, which likewise corresponds to the order of their date. Before being put away, however, they are indexed in a card indexing system as described below.

A topical index of engineering subjects based upon the decimal system is used. This index is made to follow as rational a plan as possible and after a few weeks of use becomes sufficiently memorized to enable one to locate cards without reference to the topical index.

Each topic has a card made out according to the plan shown below and each article or other reference is entered on a separate line of the card with its serial number, date and source opposite to it. Instead of cards, sheets in a loose leaf note book may be used:

E — 630 Electric Locomotives.

1041	New York Central	E. W. 1-5-08
1096	B. & O.	E. R. J. 2-6-08
1143	N. Y., N. H. & H.	E. N. 4-21-08
1220	Brooklyn Rapid Transit	G. E. R. 6-18-08
Ref.	Elec. Locomotives	Trans. I. E. E., p. 29, Vol. 50.

(The letters in the last column are abbreviations of technical journal titles.)

Size of card is 6 × 4 ins.

The advantages of this system are as follows:

Compared with Simple Indexing:

(1) Articles are available in the office at short notice.

(2) Bulk of data filed is reduced to minimum.

(3) The trouble and expense of book-binding is avoided; and the data are not temporarily lost to the office during book-binding.

(4) The filing of articles from miscellaneous journals, which are not subscribed for, is still possible.

(5) When all the available data on a given subject is required, one's desk is not loaded with dozens of ponderous volumes.

Compared with Simple Clipping:

(1) Articles on the same sheet may be filed without having duplicate copies.

(2) Detail topics in a general article are easily cross-indexed.

(3) It is much easier to determine whether any particular article has been filed than it is with the clipping system, especially when the file becomes voluminous.

(4) If an article cannot be found by topic, it can be found by date, as the data sheets are filed in order of date.

(5) When thinning-out becomes essential, it is not necessary to go through the whole file, but only through the oldest portion and the obsolete matter eliminated.

(6) A convenient method is provided for indexing articles in books and periodicals which are not owned or subscribed for.

(7) And last, but not least, the time which would be spent in cutting, assorting and pasting clippings is more pleasantly and profitably utilized in carefully scrutinizing the articles so that all topics of interest may be properly indexed, and as there is no temptation to defer this sort of filing until sufficient papers have accumulated for one or two days' work (as is the case with the "paste pot and shears" system), it is much more thoroughly done, and in consequence much valuable information is acquired which would otherwise be entirely overlooked.

The writers claim no originality for this system, but after a trial of other systems for several years they are prepared to recommend it as the most practical one yet suggested.

Yours very truly,

Wm. A. Dunbar,

O. G. Pratt.

335 Madison Ave., New York City, Jan. 25, 1911.

Pocket Books Containing Traverse Table for Quarter Degrees and Distances from 1 to 100.

Sir: In this morning's "Literature Supplement," Elmer Lenfest, of Snohomish, Wash., inquires for a pocket-book containing a traverse table for ¼ degrees and for distances from 1 to 100.

Such a table is given in "Tables and Formulas for the Use of U. S. Surveyors and Engineers on Public Land Surveys," a supplement to the Manual of Surveying Instructions of the U. S. General Land Office. The pocket-book is compiled under the direction of Fred. Dennett, Commissioner of the General Land Office, and it may be obtained by sending 60 cts. to the Superintendent of Documents, Government Printing Office, Washington, D. C.

John C. Trautwine, Jr.

257 South Fourth St., Philadelphia, Pa., Jan. 20, 1911.

Sir: Referring to the inquiry from Mr. Elmer Lenfest for the name of an engineer's pocket-book containing a traverse table to ¼ degrees for distances 1 to 100:

J. M. Scribner's "Engineers' and Mechanics' Companion," published by D. Van Nostrand, New York ($1.75), contains such a table among other useful tables. This traverse table has also been reprinted by the publishers as No. 115 of the Van Nostrand Science Series (50 cts.).

David W. Stradling,

Assistant Engineer, City of Indianapolis.

Indianapolis, Ind., Jan. 24, 1911.

Sir: I judge that the book Mr. Lenfest has in mind is one originally published by William Stieren & Co., Instrument Dealers, of Pittsburg, Pa. (at $1.50). The book is now to be obtained from the B. K. Elliott Co., Bessemer Building, Pittsburg, for the nominal price of 50 cts. 50 cts.

Ralph Cannon,

With G. M. Hopkins Co.

302 Walnut St., Philadelphia, Pa., Feb. 6, 1911.

Sir: I believe the table book described by Mr. Lenfest, and wanted on account of the traverse table contained therein, to be "Engineers', Contractors' and Surveyors' Pocket Table-Book," by J. M. Scribner, A. M., author of Engineers' and Mechanics' Companion, published by D. Van Nostrand; I have one of these table-books which has been in use for many years on account of the traverse tables it contains. It was published in 1884 and was the twelfth edition, revised and corrected. The price was $1.50, full morocco binding.

Hiram E. Bull,

County Surveyor's Office, Bradford County, Towanda, Pa., Feb. 8, 1911.

Literary Gems from Municipal Reports.

Sir: The quotations from municipal reports, given by Mr. Frederick I. Winslow in your Engineering Literature Supplement of Jan. 19, remind one of the introduction to the sermon of an old negro preacher:

Bredrens and Sisterens—It is wid de greates' degree ob extemporaneous prolifity dat I undresses my superannuated countenance befo' dis disinterestigated consembly t-e-r-d-a-y.

"Amen Corner."

Mississippi, Jan. 22, 1911.

The monographs, "Fatal Accidents in Coal Mining," "Recent Action Concerning Accident Compensation," "Foreign Workmen's Compensation Acts," "Cost of Industrial Accident Insurance" make up a large part of the Bulletin of the U. S. Bureau of Labor for September, 1910 (Washington, D. C.).

SCIENCE CONSPECTUS.—Published (Dec., Jan., Feb., Mar.) by the Society of Arts of the Massachusetts Institute of Technology, Boston, Mass. Vol. I., No. 1, December, 1910. I. W. Litchfield, Editor. Paper; 7 × 10 ins.; illustrated. $3, yearly.

The purpose of this new publication is

to give a general survey of the field of science and its applications in such a way that every article will have some educational value for every reader.

The first number reprints a lecture on the gyroscope, an article on the limits of the universe, and has something on atoms, eugenics, and soil fertilization, besides abstracts and notes.

REVIEWS.

A Condensed Technical Library for the Civil Engineer.

AMERICAN CIVIL ENGINEERS' POCKET BOOK.—Editor-in-Chief, Mansfield Merriman. Associate Editors: Ira O. Baker, Charles B. Breed, Walter J. Douglas, Louis A. Fischer, Allen Hazen, Frank P. McKibben, Edward R. Maurer, Rudolph P. Miller, Alfred Noble, Frederick E. Turneaure, Walter Loring Webb, Gardner S. Williams. New York: John Wiley & Sons. London, England: Chapman & Hall, Ltd. Leather; 4¼ × 7¼ ins.; pp. 1,380; 944 text figures and 495 tables. $5, net.

The new pocket-book awaited with so much interest is now at hand. The outcome of a plan prepared by Professor Mansfield Merriman, it enjoys the prestige belonging to one who has been a leader in engineering circles for many years. Prof. Merriman's text-books of engineering theory have long been used by students and older men alike. His present book is a compendium of practice instead of a book of theory; it is for the daily reference of the working engineer, and not for the student's instruction. Representing thus the most permanent work of its author, it doubtless had the benefit of his best powers. The remarkably short time in which the work was carried out—only two years from first inception to final publication—is evidence of his close application to the undertaking. We congratulate him, and with him his associates in the authorship, on the achievement.

For the civil engineer this is the first important handbook produced since that of Trautwine. Pocket-books for the mechanical engineer and for the electrical engineer have appeared in the interim, but civil engineers have continued to lean on successive revised and rewritten editions of Trautwine. The new book may be said to have an importance proportioned to the years during which the earlier work existed alone.

In the thirty-eight years since the first appearance of Trautwine's Pocket-book the engineering profession has undergone radical changes. Chief among these are differentiation of engineering work, a great increase in the number of engineers, an enormous growth of technical schools, and correspondingly a rise of the standards of mental equipment for engineers. The elder Trautwine found it necessary to adapt the style of his book to the mathematical skill of the "practical" engineer, the man who never had scientific training or else had forgotten the algebra and other refinements learned in college; and he put in his Preface a sharp criticism of theoretical text-books and their writers. To-day obviously neither of these things would be necessary. Style aside, however, the pocket-book of to-day would not be much different in its fundamentals from the pocket-book of the seventies. It would be a repository of memoranda on special peculiarities noted in materials, structures and natural processes, of numerical data, of tables and diagrams giving observed results in condensed form, of the principal formulas and their use, and of suggestive notes on methods of procedure or governing essentials.

Trautwine went farther. Having in mind the man whose technical-school education was scanty, and the multitude of subjects which the engineer might need to know or apply in his work, the author gave him a compendium of applied engineering science, expressed in simple form. Technical books were not numerous at that time, and such a compendium was therefore the more needed. These conditions are all changed now, by a great mass of technical literature and thorough dissemination of engineering science. The profession to-day is made up largely of men who have been through an engineering college. What the modern engineer expects from a pocket-book is thus no longer the same as was required in the seventies. He has his treatises of engineering theory and science. What he wants at his elbow is a compendium of practical considerations and a mine of data, tables, and diagrams.

This is one view; it is not that taken by Prof. Merriman. A rather different view is possible: that the engineer, having so many books, wants to cut loose from the incumbrance, and refer to the treatises only in rare emergencies; that for this purpose he needs a condensed summary of all his books, which however must be supplemented by an interleaving of tables and experience-notes in a way to vitalize the book teachings for practical use. In other words, he wants a pocket cyclopedia rather than a printed memorandum book.

The American Civil Engineers' Pocket Book is very closely of this description. Twelve men, under Prof. Merriman's direction and supervision as Editor, wrote twelve monographs on specific subjects or groups; each monograph is a condensed text-book, and with a collection of mathematical tables produced by the editor himself these are bound in one cover and provided with a unified index. Together, these several writings are meant to cover the full range of civil engineering activities. The old-style treatises on Civil Engineering were similar, but they included the demonstrations of theory (which in the present work are largely omitted) and omitted the full reference to practice. They placed the theory at the head, whereas such a book as this must place practice ahead.

Most important in an appreciation of the book are the personalities back of it. It is due to the subject that we list them here:

Prof. Mansfield Merriman.—Section 1. Tables of logarithms, circle functions, roots and powers, etc., with a short text guide to their use.

Prof. C. B. Breed (Mass. Inst. Technology); with the collaboration of Prof. G. L. Hosmer (Mass. Inst. Technology).—Section 2. Mapping, plain surveying, geodetic surveying, railway location and construction surveying, and associated computations.

W. L. Webb.—Section 3. Roads and streets, railway track, equipment and operation, and street railways.

R. P. Miller; with the collaboration of R. W. Boyd, T. R. Lawson, and J. S. Macgregor.—Section 4. Mechanics of materials, properties of materials, available sizes of materials, and inspection and testing.

Prof. F. E. Turneaure (Univ. of Wisconsin).—Section 5. Cement and concrete (materials, manipulation, design of structures and descriptions of typical designs).

Prof. I. O. Baker (Univ. of Illinois).—Section 6. Stone, stone and brick masonry as materials (i. e. without regard to the character of masonry structures), forms of foundations and methods of constructing them, and tools and processes of earth excavation.

W. J. Douglas; with T. C. J. Baily, Jr., collaborating.—Section 7. Design of masonry structures (walls, dams, arches, piers), and timber framing and structures (including falsework and arch centering).

Prof. F. P. McKibben (Lehigh Univ.).—Section 8. Steel structures, including roof and building frames, bridges, and such structures as standpipes, tank-towers and bins.

Prof. G. S. Williams (Univ. of Michigan).—Section 9. Hydraulic theory, computations of flow (pipes, weirs, orifices, channels), water measurement, water-wheels, pumps, and investigations of water-power and the associated conditions.

Allen Hazen; with H. M. Wilson collaborating.—Section 10. Water-supply, sewerage, water purification, sewage disposal, irrigation and drainage.

Alfred Noble and S. H. Woodard.—Section 11. Dams (fixed and movable), aqueducts, canals (and locks, lifts and inclines), shaft sinking, test boring, tunneling (rock tunneling, ordinary soft-ground tunneling, shield tunneling), and city subway construction.

Prof. E. R. Maurer (Univ. of Wisconsin).—Section 12. Mathematics, mechanics and the influence of friction on motions.

L. A. Fischer (Bureau of Standards); with C. E. Walters, A. W. Gray and H. B. Brooks (all of Bur. Stds.) collaborating.—Section 13. The elementary chemistry and physics of engineering, thermodynamics, electrical phenomena and electric machines, meteorology, aeroplane flight, and weights and measures.

That these men all have recognized qualification to write of their respective subjects the reader will note at once, as also the fact that the list includes pre-eminent authorities, without whose assistance a result equally excellent could probably not have been secured. Moreover, every section and chapter is of quality fully corresponding to the standing of its author. Indeed, we will not go far wrong in saying that every one of the authors has raised his standing, has gained a higher and more lasting place in the esteem of the profession's present and future members, by his work on this book.

The product of these worthy labors has been put forth in fitting dress. Our personal association, perhaps, leads us to notice first (after the clear typography and the well-judged choice of size and spacing of type) the high degree of exactness of the text—i. e., the great freedom from typographical errors. The occasional *Ferret* and *Brinnell* stand out by contrast. The arrangement of type and cuts, the printing, paper and binding are equally excellent, and the illustrations in large part also. Special notice is due what might appear to be a very subordinate feature: A size of page was chosen which makes the book markedly handier than any existing pocket-book. It is somewhat wider and considerably higher than the usual page; mainly through the latter increase the page gains in contents and readability, and the finished volume gains in convenience, to an extent that will earn every user's appreciation.

A book produced under these auspicious conditions, and by virtue thereof occupying a commanding position in civil engineering literature, claims more thorough review than a simple appreciation in general terms. A somewhat detailed survey is required, to furnish specific terms from which to form opinions suited to individual uses and needs. At the same time the commanding position of the book carries with it large responsibilities, and therefore it must be tested by more rigid specifications than would be applied to another work. This means criticism where needed. Even without this a closer review will unavoidably lead to various criticisms, in the way of statement of limitations and the like. For, as in the case of any other excellent production, the book can hardly be characterized otherwise than by pointing out particulars wherein it falls short of perfection.

Referring generally to whatever shortcomings the work may have, it is noted that these mainly spring from the general plan and apportionment, rather than from the treatment of the resulting parts by the section authors. For this, if we read the preface right, Prof. Merriman assumes full responsibility.

That there is no treatment of river and harbor work, shore protection and marine construction; none of dry-docks, fixed or floating; practically nothing on building construction; that abstracts of structural and soil geology and mineralogy are lacking; that so frequent a constructional operation as trenching (by all odds a practical matter, not a text-book subject) is left unconsidered; such omissions as these must be regarded as coming from the general plan. And while the preface speaks of minor omissions, some of those noted are doubtless major. Overlap, duplication and splitting-up of integral subjects are equally chargeable to apportionment; for example, the fact that dams are discussed in some three different places. We do not venture to judge whether and how well these deficiencies could have been avoided; the user of the book is concerned only with the results of the authors' labors. A careful examination of the schedule of contents will inform him as to whether the subjects in which he is or may be concerned are duly represented in the book. As to overlaps he is assisted by a creditable subject index,* very extensive, which should suffice to guide him to *all* the references to a given subject.

One other general comment on shortcomings is in place here, namely: that the proportion of tables, working diagrams and such-like concentrated substance is smaller than would be expected of a pocket-book. This seems to come from the plan followed by most of the section authors of dealing with their subjects in the style of a condensed text; the view that the contents should be those of a practicing engineer's note-book *auxiliary* to texts and treatises did not receive full recognition. Be it said in justice, however, that the tables which the book contains show in their mechanical arrangement a careful study of the user's needs. Not only do no tables run the wrong way of the page, but sidewise column-heads have been avoided everywhere, often at a sacrifice of space. Headings and side notes are planned with care to remove all ambiguities or unclearness.

Beginning a closer review, we find in Sec. 1 (40 pp.) a well-chosen collection of tables, even including areas of circles and volumes of spheres tabulated separately for diameters in decimals and diameters in *units and eighths*. A short table

*Prepared by C. L. Bogert.

of hyperbolic functions, a skeleton table of Naperian logarithms,* amplified by a modulus multiplication table, and a good table of constants are also noteworthy. Prof. Merriman introduces the novelty of a five-place logarithm table for three places of numbers, quite out of harmony with usual practice, and similarly a five-place log sin-log cos table for 10-minute intervals; the advantage in both cases is to bring the table within the compass of two facing pages, but the omission of the last place would have done even better. Incidentally, the purchaser of the book should correct the heading of the square-root table, pp. 20-21, to avoid a possible error.

In surveying there is perhaps more constant need for reminders of the underlying theoretical considerations than in most other classes of engineering work. Prof. Breed follows the recognized plan of surveyors' manuals in giving in Section 2 a condensed text-book statement of the subject. Instrumental adjustments, solar observations, survey methods and accuracies, etc., are given in compact form. However, the teacher's plan of treating land surveying and city surveying separately does bring duplication and splitting-up, which in a pocket-book is disturbing; measuring lengths or setting marks may require modified procedure in one case as compared with the other, but the operations remain the same. Prof. Hosmer's chapters on celestial observations and geodetic surveying are brief, but probably ample for the purpose of this book. When we come to railway location, the economics of location might be looked for, but the author omits this phase of the matter and confines himself to detail procedure. Most space is given to railway curves. Twelve pages on earthwork computations are good. The whole section covers 143 pages.

Mr. Webb, treating of Roads and Railways, interlaces the matter on roads with that on steam railways; on the other hand he keeps electric railways quite distinct. Roads and Streets will hardly satisfy those who have to deal directly with the subject. The treatment is essentially one of pavements, but as such is not free from serious objections; for the rest, auxiliary street details are not mentioned (not even gutters and sidewalks), nor are grades, and crowns are dismissed rather briefly.

The text on pavements gives no recognition to bituminous binders for broken-stone roads, nor to the use of surface treatment by oils to rebind and to prevent dust. But "Bitulithic," a patented tar-macadam or bituminous concrete, is referred to as though it were a class, and "Petrolithic," which is not a pavement but merely a method of carrying on the surfacing work, is ranked as a distinct form of pavement and indeed is accorded intemperate praise.

Turning to railways, Mr. Webb does excellently on the whole. Railway track, yards and buildings are discussed in good fashion, except signals; locomotives and cars, and especially data on track maintenance, operating costs and revenues, and results of state appraisals of railways, are very commendable. Here also we come to location economics, but the reader of Sec. 2, on railway surveying, is not referred to these pages.

The lengthy treatment of electric railway construction is in many respects excellent, but necessarily covers only parts of its subject, which incidentally leads to several errors of omission and commission. Track and line construction are detailed down to bonds, but a better treatment of ordinary T-rail for city streets and some reference to the general problem of co-ordinating rail and pavement would be expected, particularly in a combined section on pavements and railways. Conduit electric railways are forgotten. The subject of transition curves for street railways, belonging in surveying, occurs in Prof. Webb's section; but he says nothing of superelevation, or of the need for transitions on different kinds of electric railway. The whole section comprises 125 pages.

The author is not always conservative. He informs the reader that steam locomotives have only a small proportion of their weight on drivers *because* they do not need more adhesion; this slips in while speaking of electric locomotives. He teaches that culverts need not be designed to pass maximum floods, and that it may be preferable to suffer occasional washouts.

Mr. Miller and his collaborators have written a very creditable section on stresses and materials (133 pp.). Naturally it is rich in empirical data. Testing, in our view, should have been treated more fully, as its multiplex details are so intimately related to all questions of quality and service of materials. That nothing is said of segregation and the like in steel, or of the chemical and physical variations occurring in rolled material, is also to be regretted. But these deficiencies, together with such others, as the citation of a doubtful formula for crane-hooks, do not suffice to detract appreciably from the excellence of the section.

The condensed-treatise plan of writing impresses its stamp on Prof. Turneaure's section a little more markedly than on some of the others. Incidentally, this section deals with cement and concrete as materials, which separates them from the treatment of materials in the preceding section. More distinct misplacing, with duplication, is represented by the inclusion of retaining-wall theory (which has a special place in Sec. 7), as though retaining-wall theory were peculiar to concrete. On the other hand, concrete piles are not adequately discussed, and the reader is not referred to their discussion in a subsequent section. A marked text-book characteristic appears rather objectionably in the following point: By bringing out his several strength figures of concrete bit by bit, in step with the progress of the text development, the author fails to put them all together before the user in any one single place. There is a certain amount of rather thin descriptive matter on different types of concrete structures, illustrated with undimensioned drawings, which has more value as advertising the wide range over which concrete has been applied than as posting the engineer on easily-forgotten facts and data.

More specifically, the section opens with matter on cement as a material (including specifications and methods of testing), and on sand, mortar and the factors of strength of mortar. Some passages on natural cement, on chemical action and on slag cements invite difference of opinion, but the chapter as a whole is excellent. Concrete is split up into plain and reinforced; but all that is given under the former head applies to the concrete in a building as well as to that in a dam. A page on forms for concrete work is sadly inadequate; another page on the same subject some 30 pages further along does not add much, and the subject is left without that full mention of practice and precaution for which it gives opportunity. Reinforced concrete is divided into buildings and miscellaneous structures. Under the former head the theory of beam design in reinforced concrete is given, with formulas, diagrams and tables (but nothing is given on flat-slab floors); columns are discussed with citation of test results; and there are remarks on roofs, walls and forms therefor. Under miscellaneous structures we find general remarks on applicability of the material to bridges, foundations, retaining-walls, etc., and theoretical considerations on stresses in foundations, retaining-walls and chimneys. The section covers 89 pages.

Prof. Baker has made of Sec. 6 (79 pp.) a short restatement of matter on masonry and foundations, with an ultra-short chapter on earth excavation. Stone and stone-cutting is weak in figures. Stone and brick masonry, while weak on brick, serves its purpose; the fact that cement and lime-cement mortars are not mentioned is to be criticized. The important chapters on foundations deal separately with foundations on land and foundations in water, but the separation is not exact, pneumatic caisson work, for example, being not mentioned under the former head. A good text is given on safe loads, examinations of soil, wall footings, etc. Chimney footings are treated here, as also in the preceding section and in Sec. 7 (with no cross-referencing). Steel grillage footings, it is stated, were *formerly* much employed. Piles and pile-driving are well treated, but there is a misleading table of observed and computed load-capacities (misleading because giving the impression that piles are always stronger than their computed capacities), and the frequent breaking of piles in driving is not enough emphasized. The failure to speak of pile foundations in water is a regrettable omission, as these structures are not separately mentioned under the head of foundations in water. The latter head contains matter on diving and coffer-damming, which while good will still leave many open questions in practice. Crib foundations and open cylinders sunk by dredging are then treated; under the latter no reference is made to the extensive and excellent applications by English engineers. The use of the term caisson for such normal-air structures is rather objectionable in these days of pneumatic sinking. Pneumatic caissons, which have 6 pp., merit fuller and more exact treatment, now that they are used so extensively, and should have been illustrated by modern examples. For all these driven foundations, the matter of skin-friction is important; the author properly discusses this, and would have done better with newer and fuller data. His omission of theorizing on penetration resistance of piles, etc., is creditable. The freezing process has a page, but consolidation by cement injection and by pumping down the groundwater are not mentioned. In general the chapters on foundations are markedly didactic; their value to the practical man is doubtful.

Fourteen pages on earth excavation, appended to this section, represent all that the book contains on this important subject. Under the circumstances it is entirely inadequate. It comprises mainly 4 pp. on scrapers and graders, 2 pp. on loading and hauling, 2½ pp. on steam-shovel work, 2 pp. on levees (a type of structure, not a method of moving earth), and 2 pp. on dredging. Since earthwork is a fundamental operation in engineering construction, and its aggregate cost is enormous, it might fitly be accorded more than this 1% of the book's volume.

The treatment of Masonry and Timber Structures in Sec. 7 (127 pp.) by W. J. Douglas comes quite close to "practical" demands. But the author permits himself to drop into phrases like "a formula frequently given for this case," and "some writers recommend," which do not speak to the user of the book with that degree of personal warranty required in a handbook, in the absence of specific reference to authorities.

In some 75 pages on masonry structures the author gives data and design in excellent manner, concisely and from the viewpoint of practice. Retaining-wall design, empirical rules for walls of buildings, design of dams and arches are all of this character. The subjects piers, dams and retaining-walls are also treated in other sections, by either equivalent or supplementary matter, but references are absent, as usual, throughout the book. The theory and practical considerations governing dams find a valuable supplement in the full album of dams given by Noble and Woodard in Sec. 11. Since precedent controls even more in design of retaining walls than in that of dams, a similar album of walls is even more necessary; but Sec. 11 does not give it, and it should therefore have been included by Mr. Douglas. A reference to Prof. Turneaure's discussion of reinforced retaining walls then added, the book could have been said to dispose of the subject in highly satisfactory shape. Some tables of weights of soils, included for use in retaining-wall calculations, bring to mind that the book does not anywhere contain a table of unit weights where all substances are brought together. Incidentally, one of these tables is of uncertain meaning, purporting to give a list of weights of soils in water. Mr. Douglas prefers the Washington (D. C.) rules for thickness of walls of buildings to those of New York, and as a result he takes no account of the influence of unbraced length of wall. In base-pressure calculations he introduces the awkward term "kern," a transfer from the German. Under theory of dams he deals exclusively with the conventional theory of uniformly-varying pressure; an earlier reference to rubber-model experiments is not sufficient to draw attention to the various modern studies of stress-distribution in dams. The table of large

*Prof. Merriman avoids the term "natural" logarithm, apparently because of the different use of natural in "natural" trigonometric functions, a commendable course.

arches is not up to date. But though, in such points as these, differences of judgment may suggest criticisms, the author's and Mr. Baily's eminently practical, concise and correct treatment of design of masonry walls, dams and arches must be accorded full credit. The chief limitation is that they stop at design and say nothing of execution of the work, except for three pages on arch construction.

Timber design refers principally to heavy construction, as for trestles, falsework and large roof-trusses. The data (permissible stresses, fastenings, joints) are very well treated. Some tables here included, as of nails and screws, belong in Sec. 4, and the table of allowed stresses for wood should have been coordinated with the strength table in Sec. 4, p. 368. Connections of timber with steel and masonry might have had mention. Timber wharves are discussed very briefly; the rules of practice governing trestles and timber bridge-floors are stated rather more fully. Falsework for bridge erection is discussed as well as the scant space of two pages permits, though the illustration is for a highly special case. The 8-page discussion of arch centering has the backing of the author's considerable experience with these structures. The design of wooden trusses is handled scholastically; a poor Howe truss is shown.

Prof. McKibben, treating of steel structures in 125 pages, presents in approved style the matter found in our standard treatises, and in practically the same order and arrangement. He gives over two-thirds of the space to bridges, and only one-sixth each to building frames (including roofs) and miscellaneous structures (as viaducts and towers). The matter on mill and tier-building frames is quite descriptive, or we might say statistical; while under roof-trusses the course of design is stated. We miss a guide to the analysis of portal-braced building frames, as indeed two pages is hardly adequate for tier-building frames. Bridges are well introduced by a classified abstract of several good specifications. Before this point is reached, a summary of facts on strength and other features of structural elements would have been in order, including a discussion of riveted joints with regard to non-uniformity of rivet-service and non-central stress. There are useful notes on bridge floors, on transportation and erection, etc., all of service to the designer. Plate-girders are treated both descriptively and for design. Coming to simple truss bridges, stress analysis is handled rather concisely, proportioning of details more fully. The methods of analysis of swingbridges, cantilevers, arches and suspension bridges follow in consecutive order; the treatment of swingbridges is especially thorough, and here also something is given on turntable and machinery. Finally, the matter on viaducts, stand-pipes, elevated water-tanks and bins is very brief indeed, both as to the small number of structures considered and as to the variety of forms and practical difficulties of those mentioned.

It must be recognized that this section presents the most perplexing questions as to what material should be given, whose needs—those of the steel designer or those of the engineer not familiar with steelwork—should receive primary consideration, and in what extent the intricate details of the subject should be set forth. The steel draftsman's work, for example, could be helped by a great many tables, formulas and hints. We do not venture an opinion as to how these questions ought to be answered. As to the present treatment, a review indicates that neither the designer nor the draftsman is likely to find much aid, the latter because his special difficulties have been left unconsidered, and the designer because with isolated exceptions the matter given is a part of his current mental stock, requiring no reminder. This section would appear likely to be called upon most often by the engineer not familiar with steelwork. But if his viewpoint is to govern, a more condensed treatment would be adequate and through its simplicity and compactness more serviceable.

In section 9, Hydraulics, Prof. Williams gives first some general laws and equations of motion, and then prefaces computations by a valuable table of powers of numbers. This table gives n^2, $n^{1.85}$, $n^{1.97}$, their reciprocals, $\sqrt{2g}n$, and $n^2/2g$, for values of n from 0.01 to 20. Then follows discussion of the common cases of hydraulic flow, i. e.: orifices and tubular mouthpieces, capillaries and soils, pipes (with remarks on flow of air, oil and water-sand mixture through pipes), weirs, and open channels. The formulas are given with precise comment on range, accuracy, etc. Under orifices, a note gives an approximation for gratings, but not definitely enough in view of the subsequent statement that the head lost in screen-racks of water-power intakes is serious. There is nothing on hydraulics of fire streams. Under pipes, there are tables of the Chezy coefficient C for cast-iron and riveted pipes. The hydraulics of water-hammer in pipe systems might well have been discussed. Formulas for air flow are given, with no reference to actual measurements. Weirs and orifices are supplemented by fuller discussion farther on under "Measurement of Water." For open channels the Bazin formula is stated to be the best, and tables are given for Bazin and Kutter coefficients; but the author recommends an exponential formula, with stated values, as giving results fully as accurate as the observations warrant. Transporting power, backwater and like phases of stream flow are briefly noted. Measurement of water contains tables of weir discharges by Bazin's formula, tables for several dam forms, and remarks on current-meter and Pitot tube work.

Turning to hydraulic machines, the author devotes nine pages each to turbines and pumps. The fundamental formulas of turbines are given, and type characteristic is discussed. There is a table of influence of speed variations, and tables of size, speed and power for various sizes of the turbines of seven different manufacturers. A table of this sort is also given under centrifugal pumps. Descriptions and statements of efficiency are given for reciprocating pumps and miscellaneous types of water-lifting machines. Hydraulics then shifts to hydrology, in a short chapter on water-power preliminaries. There are tabulated data on rainfall, runoff and flood discharge for American streams (not always of recent date), and the computation of equalizing storage is set forth. Here the section virtually ends. A short 2½ pages on Design of Power Plant appears valueless and has many misleading statements, for example statements as to voltages, and a missed attempt to define power-factor. The section comprises 83 pages, generally very well utilized, as the author's high standing would promise.

Mr. Hazen devotes 83 pages to water-supply and sewerage. Short, concise statement for the most part, comprehensive treatment and good reference data characterize this part. Water-supply has the greater space. Sources and amounts of supply, methods of taking water and notes on storage open the subject. Intake pipes are discussed separate from other pipe lines. Under wells there are references to Prof. "Schlicter." The quality requirements for drinking-water and boiler water are well stated. Water purification is introduced by a general survey of methods, following which sedimentation and filtration are discussed, the latter in great detail. Excellent data are presented. Sand ejectors have the disproportionate space of three pages, although already shown in Prof. Williams' section. Distribution piping and water consumption are equally full of pertinent information; the procedure for designing pipe systems might have been worth a reference. There is a good estimating table for stand-pipes, but only six lines of text on elevated tanks. Data on cast-iron and riveted steel pipes, on gates, meters, etc., and on pipe cleaning follow; a page is given to electrolysis, with no positive recommendations.

Sewerage has data on storm-water runoff, and brief discussion of sewer sizes and grades and sewer maintenance, leading up to sewage purification. Here are statistics of sewage composition, notes on purification by dilution, and fuller data on sedimentation, septic and chemical processes, broad irrigation, and filter-bed processes. Earlier, a wholly inadequate 1½ pages on refuse disposal finds place; this consists of some tables of amount and composition of municipal refuse, and just 21 lines of text!

Mr. Wilson concludes the section with 26 pages on irrigation and drainage, which contrast with the concise treatment of Mr. Hazen's subjects. An unduly official cast is given to the chapter by citation of federal and state laws governing irrigation and swamp drainage. The technical matter, however, is helpful.

Messrs. Noble and Woodard have filled their 103 pages with highly practical matter. Dams are treated mainly by showing sketch sections of a large number of dams, and giving a few lines of data on each, assembled in compact form. Masonry, reinforced and steel dams are thus treated. Timber dams, ordinary earth embankments, hydraulic-fill and rock-fill embankments, and overflow dams have text discussion, a data list being omitted only in the case of timber dams. Finally, four pages give illustrated descriptions of types of movable dams, with data tables for needle dams, Stoney gates and Chanoine wicket dams. A short consideration of reservoir outlets and fishways completes the subject of dams. For aqueducts the plan of sketch sections and data tables with amplifying notes is well continued. The subject is divided into flow-line conduits of masonry, siphons and pressure tunnels (partly intermingled with flow-line aqueducts), reinforced-concrete conduits (both flow-line and pressure), wood-stave pipes and timber flumes. Nothing is said on selection of size and shape of section or of gradient; size is presumably left to hydraulics, while shape and grade are illustrated by the listed cases from practice. Thirty pages on canals follow, with pointed discussion and direct practical data and rules for all phases of the subject. Canal sections are illustrated by data and sketches. Side-slope protection and means of reducing percolation are well discussed, with sketches. The water problems of canals, and the subject of boats, have due treatment; towing and problems of power operation are not mentioned, however. Locks, lock-gates, safety gates, lifts and inclines (without mention of other water-saving devices, or of siphon spillways) are covered saitsfactorily, the latter two chiefly by tables of data. There are two pages each on statistics of boat canals and of ship canals. Power and irrigation canals are briefly but well considered, and here also is something on permissible velocities.

Shafts and tunnels occupy 34 pages. Methods of shaft sinking are briefly described, and good hints on making wash and core borings are given. The treatment of tunneling bears the mark of the authors' experience. Timbering methods are reviewed in six pages, rock tunneling methods very briefly in two. A long table with sketch sections and six pages of notes give data on actual tunnels. Then shield tunneling is discussed. This subject is amply illustrated, and has data tables on shield dimensions (separately for full shields and roof shields), on cast-iron tunnel lining, on calking, and on air supply. Under the use of compressed air without shields, the water-works tunnels at Milwaukee, Cleveland and Chicago deserved mention. A table of subaqueous tunnels is the chief omission among the second tables of this section. A page of text on city subways and a group of sketch sections have little more than suggestive value.

Prof. Maurer gives a very good condensed mathematical memorandum book. In the part likely to be most used by civil engineers, trigonometry, he drops into Greek letters, needlessly. He earns credit by a good table of integrals and several tables of interest and annuities. A little space devoted to least-square evaluation might have proved an occasional convenience. After the mathematics, the principles of statics and dynamics are summarized, and much space is properly given to methods and memoranda on centers of gravity and inertia. Statics includes methods of truss analysis. Dynamics includes a page on the gyroscope; the formulas, however, are lacking. The section concludes with ten pages on friction, where are given notes and data on pulley friction, brake-shoe friction, bearing friction, and friction losses of some ele-

mentary mechanical combinations. The total space is 99 pages.

Coming to the concluding section of the book, occupying 87 pages, we find matter of quite diversified kind and value. In the earlier parts, chemistry and physics, data are found that would be looked for under Materials, or elsewhere in direct conjunction with subjects in which the substances or processes are involved. Here appears the only matter in the book on fuels and on explosives; what is given on the latter is not at all adequate, when blasting is so common an operation in civil engineering construction. The chapter on thermodynamics is written from a physicist's standpoint, and is inappropriate in this work, besides containing some statements hard to comprehend or of doubtful character, as some remarks on entropy. Almost exactly the same is to be said of the 21 pages on electricity, which suggest a total misconception of the purposes and scope of a civil engineer's pocket-book. In its last few pages, some of Prof. Webb's matter on electric railways is duplicated, but the author (Mr. Brooks) boldly contradicts Prof. Webb by saying that the cost of car-heating by electricity is not materially different from that of heating by coal stoves.

Meteorology gives a table by which to foretell the weather—an invaluable accomplishment. There are good data on temperatures, rainfall, evaporation and wind velocities in the United States. Full lists of weights and measures and tables of conversion factors and their multiplication tables then follow (22 pp.), the latter in inordinate fullness. Under foreign measures, values of Japanese and Russian measures are given to eight decimal places (!) the Chinese to seven places only. There might have been more detail on log rules and miner's inch, and some other unusual measures might have been included. A table of the value of foreign coins fitly concludes the section and the work.

We have already referred to the index. Covering 66 pages it would not seem to err by overbrevity, yet in fact its entries are oftentimes too stenographic, i. e., not sufficiently explanatory, so that the user must sift out the right reference of a group by trial. However, some tests indicate that it is unusually comprehensive—a prime virtue in an index.

If an index is a necessity, bibliography may be classed as a luxury. This is not provided. Scattering references are given, but nowhere with the clear object of directing the reader to the literature of the subject. The need for such citation in a pocket-book may be questioned, of course. So also there need be no criticism of the authors' failure in many cases to refer theories and facts to their originators. It may be said that the plan of the book makes every statement rest on the shoulders of the one who wrote it, he presumably being sufficient authority for the statement.

We have thus in the work before us a compendium of information on civil engineering covering a remarkably wide range, presented by authorities, and possessing a high degree of correctness. With very minor exceptions the most modern view of the subjects treated is portrayed. The coordination of the contents is strikingly weak, and completeness cannot be claimed. The practical viewpoint is not fully attained. "Simplified spelling" is used, but no abbreviations such as those made famous by Trautwine.

WATER TURBINE PLANT.—(A Short Practical Treatise.) By Jens Orten Böving, M. Inst. M. E., London. London: Raithby, Lawrence & Co., Ltd. (Thanet House, 231 Strand, W. C.) Cloth; 9 × 11½ ins.; pp. 197; 216 text illustrations and 10 tables. 10s. 6d., net; American price, $4.20, postage extra.

This elaborate work is a sort of combined treatise and consolidated trade catalog, since it deals in a rather superficial way with the theory, design and use of hydraulic turbines, and at the same time shows main dimensions, general arrangement, accessories, etc., of machinery built by concerns with which the author has been closely connected. Only two types of water wheels are discussed (1) the Francis turbine for comparatively low heads and (2) impulse wheels for higher heads. Nothing is said about dams, conduits, piping, flow, etc. There are illustrations of apparatus installed in many plants which the reader will infer the author designed or built. Most of these are in Norway and Sweden, but a few elsewhere as in Canada and Japan.

Lectures on Chemistry, Engineering, Personal Hygiene and Other Topics.

MUNICIPAL CHEMISTRY.—A Series of Thirty Lectures by Experts on the Application of the Principles of Chemistry to the City. Delivered at the College of the City of New York, 1910. Edited by Charles Baskerville, Ph. D., F. C. S., Professor of Chemistry and Director of the Laboratory, College of the City of New York. New York and London: McGraw-Hill Book Co. Cloth; 6¼ × 9½ ins.; pp. 526; 251 illustrations in text. $5, net.

The title and sub-title of this book would lead one to expect a series of lectures explaining how the principles of chemistry have been or may be used to solve the many complex problems of the modern city. Instead, the reader finds a collection of addresses on a variety of topics. Some deal with sanitation, some with engineering, others with personal hygiene, and still others with materials of commerce or industry. In so far as any branch of civil government has anything to do with the topics treated, the city is most often concerned, but the state and the nation are also involved. Chemistry is not more than remotely hinted at in some of the lectures and in but few of them is it such a dominant note as would be expected from the title page.

All this is no reflection on the many eminent gentlemen who gave the addresses, for as a rule they appear to have done justice to the topics assigned them, all governing conditions considered. A partial explanation of the heterogenous character of the collection of lectures, when considered in relation to the title they bear, may perhaps be found in the two quotations which we insert here. The first is from the Preface to the book before us:

> A careful study of municipal affairs shows that the greatest material need of our American cities to-day is the chemist. It is unfortunately true that the position of the chemist in the municipal body politic is uncertain, if indeed it exists. This is due in a measure to the conception of the role of a chemist by the people, who look upon him as an analyst and not as an important social factor.
>
> One of the objects of these lectures has been to correct this condition of affairs. It is believed by the writer, who has given the matter the most careful thought, that if each city in the United States, and in other countries as well, established a scientific commission of power, unhampered by political, social, religious or official associations, to advise with the authorities on all practical matters, the public weal would be improved in many ways and its affairs more wisely administered than by any of the reform movements now in force which, by virtue of their organization, must be temporary.

The second quotation is from the presidential address delivered only last December before the American Chemical Society at Minneapolis, Minn., by Prof. Wilder D. Bancroft, retiring president:

> Now that we appreciate fully that physics, geology, engineering, physiology, medicine, botany, zoology and biology are sub-divisions of the broader science of chemistry, we see that the chemist of the future must know a great deal more than any of us now do if he is to keep in touch with the whole subject.

If these two quotations reflect the present-day attitude of chemists, then of course there is scarcely a subject under the sun which they may not be expected to include in a series of lectures or essays on chemistry, if their fancy leads them out into the highways and hedges to gather lecturers in to serve an intellectual feast. But if so much is suddenly claimed for chemistry doubtless much educational work will have to be done before "the people" mentioned in the first quotation will give up their conception of the chemist "as an analyst" rather than "as an important social factor."

We trust it will be understood that we have no quarrel with the chemists for seeking recognition socially as well as professionally, and particularly not for wishing to do all they can in the great municipal field. Like members of the engineering and other technical professions they may very properly seek fuller recognition from men of affairs and of culture alike, but in doing this the whole technical brotherhood should conform to the well-established rules of good taste and common sense.

Coming now to the lectures themselves, we find that the opening one is on "Sanitation and the City," by the editor of the series. This is followed by three on municipal water-supplies. Of these one on "Drinking Water and Disease" and one on "Purification of Water" are by Prof. Wm. P. Mason, of Troy, N. Y., and the third by Mr. Alfred D. Flinn, M. Am. Soc. C. E., describes the new Catskill water-supply for New York City. These are followed by lectures on milk, foods and drugs (seven in all, by five different men, including Dr. H. W. Wiley, of the U. S. Department of Agriculture). Next come lectures on streets and on roads, by Mr. A. S. Cushman, U. S. Office of Roads. Street cleaning, and garbags and refuse disposal, including reduction plants and refuse destructors come next, then sewage disposal (Prof. C.-E. A. Winslow), gas making and testing, smoke prevention, and ventilation.

Perhaps no lecture in the book is in better keeping with the "chemistry" portion of the title than Prof. Thos. A. Storey's, "The Chemistry of Personal Hygiene"—but what this has to do with the "Municipal" half of the title it is hard to see. The same lack of relation to municipal affairs applies to the succeeding chapter, "Textile Materials and their Service to Man."

Of the last six lectures two are on combustibles and explosives (A. A. Breneman); one each on "Paint," "Corrosion of Iron and Steel" and "Cement and Concrete" (Maximilian Toch) and one on "Parks, Gardens and Playgrounds." As to the latter, the only thing suggesting a relationship with chemistry is the last sentence but one: "Chemical examination of the composition of the soil is therefore desirable from time to time, as furnishing information as to its needs."

Of the many illustrations in the book, some are as little related to the title and subject as some of the lectures; a few are very poor half-tones; and a number of the sample score cards and the like, accompanying "Milk," have been so overreduced in reproduction as to be scarcely legible without eye strain, and that quite without necessity, since the blocks are much narrower than the text.

The volume might have been improved at points by closer editing, for surely the editor must know that "trenching for sewer or water construction" in land filled with garbage and city refuse does not "almost invariably cause an epidemic of disease in the neighborhood" (p. 258). Even if the editor be pardoned for such an oversight what excuse can there be for letting this very unhappy expression (p. 265) get into a printed page:

> Acts of God and enemies of the King have been recognized from time immemorial as necessary evils of any business.

THE SLIDE RULE; A PRACTICAL MANUAL.—By Charles N. Pickworth, Whitworth Scholar; Editor of "The Mechanical World," Author of "Logarithms for Beginners," Etc. Twelfth edition. New York: D. Van Nostrand Co. Manchester, England: Emmott & Co., Ltd. London: Whittaker & Co., and Emmott & Co. Cloth; 5 × 7¼ ins.; pp. 118; 34 illustrations in text; table and appendix. $1, net.

Some new slide-rules are described, and a few pages on gage-points and other marks are appended, in this re-edition.

SMOLEY'S TABLES.—Parallel Tables of Logarithms and Squares, Angles and Logarithmic Functions Corresponding to Given Bevels, Five-Decimal Logarithmic-Trigonometric Tables, Natural Trigonometric Functions, Including Secant and Cosecant; Squares, Cubes, Square Roots, Etc. For Engineers, Architects and Students. By Constantine Smoley, C. E., Assoc. M. Am. Soc. C. E.; Principal, School of Civil Engineering, International Correspondence Schools. Sixth Edition, revised and enlarged. New York: The Engineering News Publishing Co. London: Archibald Constable & Co., Ltd. Flexible morocco; 4¾ × 7 ins.; pp. 500. $3.50, net.

In the sixth edition the tables of natural trigonometric functions are enlarged, and tables of powers, roots and reciprocals are added.

BULLETIN OF THE INTERNATIONAL RAILWAY CONGRESS, January, 1911.—"The Twenty-fifth Anniversary of the Foundation of the International Railway Congress Association," By L. Weissenbruch, General Secretary of the Permanent Commission. Brussels: M. Weissenbruch. London: P. S. King & Son. Paper; 7 × 9¾ ins.; pp. 143.

This number of the "International Railway Congress Bulletin" is notable for containing a summary of the work of the Congress in the quarter century since its establishment. The presentation of the matter in this way makes it possible to obtain a continuous record of the progress attained in that time.

Wireless Signalling.

THE PRINCIPLES OF ELECTRIC WAVE TELEGRAPHY AND TELEPHONY.—By J. A. Fleming, M. A., D. Sc., F. R. S.; Pender Professor of Electrical Engineering in the University of London, University College. Second edition, revised and extended. New York and London: Longmans, Green & Co. Cloth; 6 × 9 ins.; pp. 906; seven folding plates and numerous text illustrations. $7.50, net.

The changes seen in this second edition of Prof. Fleming's book are best summarized perhaps by comparing the present title with the one displayed by the first edition,* "The Principles of Electric Wave Telegraphy." That is equivalent to stating that since 1906 there has been great progress in the development of radiotelegraphy, and radiotelephony has become less of a dream and more of a practicality.

The general scheme of the first edition has been followed. There is first a section entitled "Electric Oscillations" in which are theories of the production of high-frequency currents or oscillations, the work of experimenters, the construction and operation of apparatus, methods of measurement, etc. The second part, "Electric Waves," gives a mathematical discussion of topics which may be grouped about the properties of an electro-magnetic medium and the propagation of waves in it. Here also is a chapter on electric-wave detectors. The third part, "Electric-Wave or Radiotelegraph," is a discussion of the development of these wireless signalling methods, followed with descriptions of apparatus and service stations. Under this head a final short chapter has been added treating particularly the theory of varying persistent oscillations to accord with sound vibrations and of reproducing these changes in audible waves again at a receiving station.

The kind reception accorded the first edition is again to be expected for the book under its enlarged title.

ELECTRICIANS' OPERATING AND TESTING MANUAL.—A Hand Book for Men in Charge of Electrical Apparatus, Repair Men, Trouble Men, Lamp Trimmers and Electricians Generally. By Henry C. Horstmann and Victor H. Tousley, Authors of "Modern Wiring Diagrams and Descriptions," "Modern Electrical Construction," etc. Chicago, Ill.: Frederick J. Drake & Co. Leather; 4½ × 6¾ ins.; pp. 359; 211 illustrations in text. $1.50, net.

In reviewing many of the technical books of this publisher, we have noted the line of "practical" books, which was being built up for men in what perhaps may be called the lower ranks of engineering effort—engine drivers, dynamo tenders, wiremen, machinists and mechanics generally. Readers may remember that these books have been found quite generally good and evidently well adapted to the needs of their intended purchasers. This is a condition contrasted to the great mass of popular treatises on scientific and technical subjects where simplicity has been confused with inaccuracy.

This book evidently seeks to give a working knowledge of only the very essentials of electrical engineering—phenomena and principles which lie back of the design and operation of generators, motors, arc lamps, incandescent lamps, transformers, converters, etc. The work of the authors seems to have been fairly well done on the whole, although it is not entirely above criticism. For instance, a simple transformer is shown, in one diagram, connected into a battery circuit. There is a warning in the text describing the diagram that this is not strictly correct but still it would have seemed better not to have intentionally made the error. In presenting the subject of arc lamps nothing has been said about the modern development of "luminous" arcs having magnetic and titanium electrodes, though space is given to the use of mercury-vapor rectifiers used with such lamp-systems. The term "wattmeter" has been used where "watt-hour meter" is meant and as the watt-hour meter section is a large one this is important. The majority of electrical engineers have been very careless in distinguishing between these two terms, in the past, but a reform has been effected recently, which the authors ought to have shared. Except as noted, however, the authors seem to have been very careful to anticipate and correct common misapprehensions.

*Reviewed by Dr. Samuel Sheldon in Engineering News, July 12, 1906.

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Translation and Enlargement of a German Book on Hydraulic Turbines.

Reviewed by LEWIS F. MOODY.*

HYDRAULIC TURBINES.—Their Design and Installation. By Viktor Gelpke, Chief Engineer, Turbine Department, Amme, Giesecke and Konegan A-G., and A. H. Van Cleve, M. Am. Soc. C. E.; M. Am. Soc. Testing Materials; Former Consulting Engineer, Niagara Falls Power Co. New York and London: McGraw-Hill Book Co. Cloth; 7 × 9¼ ins.; pp. 293; 200 illustrations in text. $4, net.

An adequate treatise in English on the theory and design of hydraulic turbines has been lacking for so many years that American designers have had to go to German literature for modern theories; or (as has been the case with a few water-wheel manufacturers) have managed with varying success to get along without any theory. Recent development in turbine construction in this country has been rapid, and has progressed beyond the old methods of utilizing stock sizes and types of turbines for any and all conditions. Modern power developments require turbine units of large capacity and of special construction, which must as a rule be designed to suit the conditions of each particular plant, involving rational methods of engineering. The situation calls for books of the type of that under review, which the reviewer therefore considers an important addition to English technical literature.

The only book in English which has treated the theory of turbines at all satisfactorily has been Bodmer's "Hydraulic Motors," which has been obsolete for about ten years. Such books on general hydraulics and power development as Merriman's "Treatise on Hydraulics" and Meade's "Water Power Engineering" have touched on the subject only briefly and in a general way. In Germany, however, a large number of important works have appeared in this field, among which may be mentioned those of Müller, Wagenbach, a large and complete work by Pfarr, and those of Thomann and Kaplan; not omitting, of course, Mr. Gelpke's "Turbinen und Turbinenanlagen," which was reviewed in this place by the late Prof. Storm Bull (Nov. 15, 1906).

The present book is largely a translation of the last-mentioned work, although it has been considerably altered by Mr. Gelpke, and important additions have been made by Mr. Gelpke and Mr. Van Cleve to bring it up to date. Mr. Van Cleve, who was Consulting Engineer for the Niagara Falls Power Co. during the time when many of the problems incidental to the largest development then in existence were met for the first time, has added much valuable material in the form of descriptions of some notable plants recently completed. Mr. Gelpke, formerly engineer with Escher Wyss & Co., of Zurich, and now Chief Engineer of the turbine department of Amme, Giesecke & Konegan A.-G., of Braunschweig, is conversant with American as well as with European practice.

The first part of the book considers the mechanical arrangement and details of turbines, penstocks, valves, gates and accessories; and all the topics covered are ably treated. The practical points, derived from experience, concerning the mechanical details of turbines, are adequately discussed, as can be seen by referring, for example, to the methods given for operating the movable guide vanes of "wicket-gate" turbines, to use the American term.

The second part gives, in much clearer form than many German works, the theory and application of the design of the turbine wheel itself, the determination of the areas of the buckets and the shape of the vanes of the distributor and runner. The method of analysis does not differ essentially from what might be called the orthodox German method, which is based on the device of dividing up a turbine runner of the usual complex form into a number of sections, bounded by lines of flow of the water filaments, each called a "partial" turbine, and treated separately. For turbines of normal proportions this method is entirely satisfactory, and leads to successful designs; but the results cannot be said to be so good when it is applied to turbines of the high-speed (or high-capacity) type, so successfully developed, largely by empirical methods—and the operation of the law of the survival of the fittest—in this country. A glance at the form of discharge space of the high-speed type of runner shown in the book will make it evident, to those familiar with American runners, that it differs materially from the wheels which have proven most successful. It is perhaps too much to expect of such a method that it shall satisfy such extreme cases; though it is probable that, with certain modifications derived from experience, it may be successfully adapted even to this type of design.

Two most valuable features of this portion of the book are the complete tables given for the different factors in the design, and the numerical examples of actual calculations which have been worked out for different designs. The treatment might, however, have been made still more thorough by including the construction of working drawings; such as must be made for the pattern-shop, and which offer many difficulties to those taking up this work for the first time. The types of wheels covered include all the modifications of the predominant Francis turbine, the Fourneyron, Jonval (of which excellent designs are shown, making this type entirely applicable to modern plants), and Pelton and "Spoon" turbines of the tangential impulse type.

The last portion of the book gives descriptions of notable developments, and, like the rest of the book, is unusually well illustrated. This portion is, for the most part, new matter, and is not made up of reprints from technical periodicals, as in the case of some other books in this field. Some of the most valuable matter in the book is contained in this latter part, in detailed descriptions of turbine machinery recently constructed by the firm of Amme, Giesecke & Konegan, embodying the most recent practice in turbine design, and giving many valuable construction drawings. In this connection it may be noted that European technical publications are almost without exception superior to American works in the completeness with which they are illustrated, giving full assembly and detail drawings of the machinery described. The dearth of such material in our technical literature is due largely to the narrow policy of many of our manufacturers, from whom it is difficult to obtain such matter. This policy does not contribute to rapid progress in the art.

The book is deficient in reports of tests and experimental data, a serious omission; and, like most new editions, contains a number of errata, such as the interchanging of figures showing the flow in Francis and Fourneyron turbines, etc. The use of the word "impulse," instead of the proper term "impact," for loss in shock, should be changed to conform with the usual practice. There is also no reason for retaining the German term "Konus turbine" untranslated. The present reviewer would also criticise the form in which the new specific speed theory has been introduced. This important method might properly have been left in the form in which it has been developed in Germany and in this country (as described in Engineering News Jan. 6, 1910, p. 23, by Prof. Zowski); but it has been altered to the following form: the specific speed or "characteristic coefficient" is defined as

$$K_n = \eta^2 \frac{P}{H^{\frac{5}{2}}}$$

where η represents the speed of the turbine in revolutions per minute, P the delivered horsepower, and H the head. The authors state "K_n is then a measure of the speed of the wheel, . . . a statement which cannot be reconciled with its corresponding in degree with the horse-power, P, and not with the speed, which occurs in the second power. It is evidently in the order of horse-power, and is really a "specific power." Its square root is what is commonly and properly, called the specific speed. This question has already been discussed by correspondence in the pages of Engineering News.

The reviewer believes that this book will forward the use of rational methods of turbine design in this country. It is not intended to imply, of course, that such methods are not being used, for the largest and most efficient turbines ever constructed have been, and are being, built in America, and no one will welcome such books as this more than the designers of this type of machinery. The book does not by any means exhaust the field, and, if it is well received, the reviewer hopes that it will encourage further contributions to the literature of this much-neglected subject.

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ENGINEERING ABSTRACTS.—Journal of the International Institute of Technical Bibliography. Vol. I, 1910. Published monthly. London, England: The International Institute of Technical Bibliography. Paper; 6½ × 9¾ ins. Subscription for non-members: One section 24s. yearly; six sections, 80s., post free.

This periodical is published in five sections, viz.: Mechanical Engineering, Electrical Engineering, Civil Engineering, Mining and Metallurgy, Applied Chemistry and a Supplement. The avowed purpose of the publication is to list and arrange systematically all books and articles dealing with Engineering and Technical Science. Each entry contains the full title and name of author, title and date of publication and a brief resumé of the article or book when the title is not sufficient to describe it.

Each section is subdivided under subheadings so as to make it rather difficult to find a known article until one has mastered the indexer's system of classification. That this would be no easy task can be seen from a list of the 13 subheadings under Mechanical Engineering: (1) General, (2) Machine details, (3) Prime motors, (4) Tools and machine tools, (5) Lifting machinery, (6) Pumps, (7) Other transport devices, (8) Machines and devices for making and upkeep of roads, (9) Railways, tramways and motor cars, etc., (10) Aerial navigation, (11) Ship building and navigation, (12) Torpedoes, (13) Weapons and munitions, military technology. Nor is this all of the elaborate classification, for under each of these subheadings are from 4 to 30 more divisions.

The entries in the index are in the language of the original. Hence the index forms a rather heterogeneous mixture for indexing. Some of the items appear to be arranged alphabetically by authors, others without any apparent system. There are, moreover, about 64 abbreviations in three languages which must be understood to correctly interpret the items.

The index undoubtedly serves a useful purpose in collecting in one publication the titles of technical articles over a broad field; but it has the disadvantage of all indexes that purport to list articles under such broad headings. For instance, in this case we see no reason why navigation and shipbuilding should be included under mechanical engineering. There are undoubtedly many instances of particular articles where a classification into one of the six branches would be difficult, and the choice of the indexer is not likely to be the same which one looking for the article would make. Nor are there any cross-indexes to help the searcher.

THE RESULTS OF THE CHEMICAL AND BACTERIAL EXAMINATION OF THE LONDON WATERS FOR THE TWELVE MONTHS ENDED MARCH 31, 1910.—Fourth Annual Report. By Dr. A. C. Houston, Director of Water Examination, Metropolitan Water Board. London, England: The Board. Paper; 8 × 13 ins.; pp. 62; 18 tables and 7 addenda (tables).

RESEARCH WORK.—Fifth Report. By Dr. A. C. Houston, Director of Water Examination, Metropolitan Water Board. London, England: The Board. Paper; 8 × 13 ins.; pp. 37; tables.

Dr. Houston's reports on the bacterial and chemical character of the London water-supply are always interesting and instructive. The annual report noted above contains additional testimony as to the value of storage, on which Dr. Houston lays great stress, even for water subjected to slow sand filtration, as is the major part of the London supply. The research report deals with bacterial studies of London water; river water, raw, stored and filtered; and also well water, unfiltered. These studies included searches for typhoid, Gaertner's bacilli and fecal streptococci.

VERRINGERUNG DER SELBSTKOSTEN IN ADJUSTAGEN UND LAGERN VON STABEISENWALZWERKEN.—By Dr.-Ing. Theodor Klönne. Berlin, Germany: Julius Springer. Paper; 6½ × 9½ ins.; pp. 124; two folding plates and 93 text figures. 5 marks; American price, $2.

The author describes machinery and methods for the straightening and finishing departments and stock storage of rolling mills. Current types are described, and the merits of different arrangements, machines and working methods are discussed.

Individualism and Collectivism.

THE CONFLICT BETWEEN INDIVIDUALISM AND COLLECTIVISM IN A DEMOCRACY.—Three Lectures. By Charles W. Eliot, President Emeritus of Harvard University. New York: Charles Scribner's Sons. Cloth; 4¾ × 7¼ ins.; pp. 135. Price, 90 cts., net.

The three notably readable and suggestive essays here presented had their origin in lectures "given orally from briefs at the University of Virginia in November, 1909." In the summer of 1910 the lectures were written out with some changes and additions.

The contrasting phases of individualism and collectivism, and the superior claims of the latter, are discussed under the heads Industries and Trades, Education, and Government. The following concise definitions, or perhaps we should more correctly say valuations, of individualism and collectivism appear at the outset:

> Individualism values highly not only the rights of the single person, but also the initiative of the individual left free by society. Collectivism values highly social rights, objects to an individual initiative which does mischief when left free, holds that the interest of the many should override the interest of the individual, whenever the two interests conflict, and should control social action, and yet does not propose to extinguish the individual, but only to restrict him for the common good, including his own.

Lest any should confound collectivism with socialism, Dr. Eliot immediately explains the difference between the two, pointing out that collectivism has no concern with such questions as the alleged "unnatural division of society into a few owners of land and machinery, on the one hand, and many wage-earners, on the other," nor with "the ultimate ownership of all the means of production, including the land, by society as a whole," nor, again, with state regulation of wages, provision of work for all not privately employed, etc. Socialism as thus conceived, the author considers to be against the best interests of the very persons whom it is designed to aid. As might be expected, the author, while approving many of the aims of labor unions, strongly condemns some of their extreme tendencies.

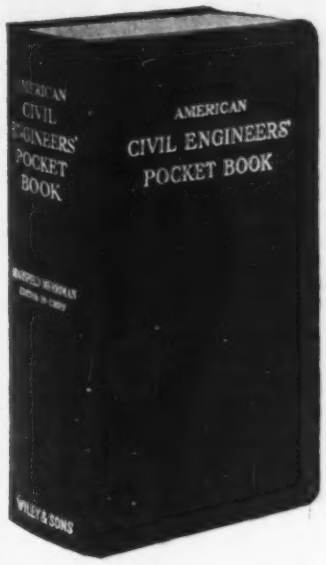
In opening the section on Education, Dr. Eliot points out the highly individualistic character of education in its primary essence, and then goes on to show how, as things are now constituted, it is absolutely necessary to conduct education very largely along the lines of collectivism. As to this peculiarly individualistic character of education, the author says:

> When Knox, Milton, Locke, or Montaigne describes the best possible education, he conceives it as addressed or applied to a single highly privileged youth. Indeed, Montaigne's ideal is one admirable tutor devoted all the time to one precious youth; and Rousseau's is much the same. When Thomas Jefferson wished to found a university, he made freedom of choice for the student among the different departments of knowledge the principal feature in his scheme. When Ezra Cornell was planning to found a university, he expressed the desire to found an institution where any one might study anything, according to his choice and capacity.
>
> It is for the benefit of the individual to bring into play at the earliest possible moment the motive of the life-career, because that is a strong interior motive and a lasting one.
>
> In a democracy all the human "sports," that is, all the children who have unusual advantageous capacities or qualities, ought to be discovered and developed through education, and then directed to the most advantageous career. This is an intensely individualistic process, as much so in human beings as in plants and animals.

Collectivism in education is described by the author in this essay. Collective action along many new lines is demanded. Thus, stress is laid upon the need of providing playgrounds and of exercising the right of eminent domain for this and allied purposes; or in other words, making society as a whole, and even individual members of it, give way to a particular class of needs of society.

In the section on Government, the author emphasizes the need for the employment of experts in various lines, just as in discussing education he laid particular stress on the need for training men for many kinds of expert work.

The only criticism we presume to make is that, in setting forth the needs for collective effort, while at the same time decrying the extremes of socialism, the author might well have drawn more clearly the boundary line between the two, as it appears to him. Some of the things which he deprecates in his remarks on socialism he almost seems to sanction, if not to strongly advise, in describing the proper field of collective effort.



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Electrical Books.

Reviewed by HENRY H. NORRIS.*

CONTINUOUS CURRENT MACHINE DESIGN.—By William Cramp, M. Sc. Tech., M. I. E. E., Consulting Engineer; Special Lecturer in Electrical Design, The Victoria University, Manchester. New York: D. Van Nostrand Co. Cloth; 5¼ × 8¾ ins.; pp. 240; 137 text figures; 8 appendixes; tables. $2.50, net.

ELEMENTS OF ELECTRICITY FOR TECHNICAL STUDENTS.—By W. H. Timble, Instructor in Industrial Electricity, School of Science and Technology Pratt Institute, Brooklyn, N. Y. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. Cloth; 5¼ × 7¾ ins.; pp. 356; 415 illustrations in text; appendix. $2, net; English price, 8s. 6d., net.

There are comparatively few electrical engineers who are directly concerned with the designing of electrical machinery. This is particularly true in the United States where a small number of manufacturers, at present, supply practically all of the demand. It is difficult for the small manufacturer to compete in this business unless he has a patented specialty, because the cost of production of motors, generators, etc., depends largely upon the number made at one time. The large companies can put through large shop orders of small and moderate-sized machines which they can afford to keep in stock. The advantage possessed by these companies is even greater in the case of large special machines which small concerns cannot afford to build. The principal types of electrical apparatus, in usual sizes, have now become well standardized, so that designing will require fewer engineers as time goes on. The effect of this condition is seen in the leading technical schools of the country in which design courses were at one time very prominent. Now the tendency is to do away with these in large part because such a small proportion of the graduates go into designing and because the fundamental principles of electrical devices can be taught better in other ways.

From the above-outlined state of affairs it follows that books on designing will not be in great demand by actual designers, no matter how excellent the books may be. It is to be hoped, however, that the electrical engineers will not lose their interest in designing, even if they never practice it. The study of the designs and corresponding operating characteristics of machines gives an insight into the underlying principles. This raises a question as to the wisdom of giving up design study in the technical schools. What is being given up is the production, in school, of detailed designs which, after all, depend for their success upon experienced judgment rather than upon theoretical formulas. Instead of this, technical students are taught to analyze the performance of existing successful machines and to study the proportions and the selection of materials which have brought about this success.

Mr. Cramp's book should be very helpful and suggestive to young men in the employ of electrical manufacturers, to advanced students in technical schools, and to users of electric motors and generators who are interested in studying the economic side of design. It is not a book for beginners and yet if the reader understands the laws of electric and magnet circuits and is familiar with the construction of standard machines he should be able to follow the text intelligently. The book gives, in reasonable compass, absolutely without padding, a comprehensive study of the proper proportioning of parts to produce the most economical result. The method of treatment impresses one with its reasonableness and its thoroughness. The author has been led to write the book because he could not find one which was not either too bulky and expensive or too highly specialized in treatment. He has therefore tried to give a fairly general survey of the field in a book of moderate size.

From the start the study is confined to modern machines of standard form. The statement is made that in the case of small machines, the over-all dimensions and the proportions for a given output are dictated by questions both of economy and appearance, while in the larger sizes economy is usually the ruling factor. The relation of the form of the frame to the materials available for the different parts is investigated. In the case of the field magnet the proportions are dictated by:

(1) The maximum densities permissible, and the ratio of the pole-arc to the pole-ditch.
(2) The watts to be dissipated in the field coils and the temperature rise of the latter.

The proportions of the armature are effected by eight factors, as follows: (1) Efficiency, (2) division of losses (between iron and copper) for a given temperature rise, (3) pressure and current, (4) standardization, (5) appearance, (6) ampere-turns of the armature, (7) commutation, (8) use of neutralization. All of these factors are discussed by the author in detail. His conclusions are based upon his own experience and upon a careful study of the literature of the subject.

The effect of the recent introduction of commutating poles upon design is shown by the space devoted to this subject and to that of temperature rise which, because of it, has assumed relatively greater importance. As Mr. Cramp points out, formerly the proportions of a machine were determined to a large extent by the consideration of sparking. When commutating poles are used the evil of sparking is eliminated and the output is limited solely by temperature rise. At present it is cheaper to suppress sparking by this means than by such proportioning of parts as will give good commutation by older methods. It is possible, however, that in time the prices of materials may so change that the older plan will be cheaper. Hence the author includes a treatment of commutation without interpoles, as well as a study of rise of temperature in all types of machines.

Throughout the book there is a wealth of data in tabular and graphical form. These data are not of the hand-book variety but represent values based upon up-to-date design practice. Cost data are included with these to show how the possible selling price affects the details of the design.

Mr. Timble is instructor in industrial electricity at Pratt Institute, where every year large numbers of earnest young men are taught this important subject. Many of the students are employed during the day and come to the Institute at night. The aim of the instruction in the electrical department, as in the other departments, is to furnish immediately usable training. The laboratory is naturally the most important adjunct in this work, as industrial training must be as much with the hands as with the head. A rather extensive laboratory equipment has, therefore, been gathered together and it is efficiently used. In connection with the laboratory and class-room work a text-book was necessary for guidance and reference. Evidently Mr. Timble could not find anything in the market exactly adapted to his needs and he has consequently prepared a text which will probably meet the needs of his classes. In this task he has been assisted by his work at the Institute and by a considerable experience with one of the large electrical manufacturing companies.

The title which he has chosen for his book is "Elements of Electricity for Technical Students." This indicates a rather broader field than the author really intended to cover. The book was prepared for industrial students, and the title should say so. Certainly that is scope enough for any book. The author calls attention to what he believes to be the chief merits of the book, namely:

(1) It contains an adequate amount of information concerning electrical laws and practice in an immediately usable form.

(2) It applies the information contained to real things and not to abstract theory and conditions.

(3) It provides sufficient drill in concrete practical problems, which not only afford in themselves an additional amount of profitable information, but also develop in the student a capacity for applying what he has learned; the large number of diagrams aiding materially in providing exact and clean-cut conceptions of the conditions of the problems.

(4) It presents, out of the great mass of electrical phenomena, only those facts and principles which a technical student needs to know, and to know well. History and general theory, interesting as they are, have been omitted.

It will be interesting to see how he has worked out his plan.

With such a broad field to cover, there must necessarily be a large number of topics to be treated. Those selected for the chapters, with the number of pages alloted to each, are Magnets and Magnetism (23), Electromagnets (13), Ohm's Law (33), Power Measurement (15), Measurement of Resistance (35), Magnetic Field due to Current (29), the Generator (40), the Motor (32), Further Applications (37), Inductance (32), Capacity (24), Electro-Chemistry (39), Photometry and Electric Illumination (24), Electrical Measuring Instruments (43), Alternating Currents (95) and an appendix containing useful reference data (21). This seems like a peculiar assortment of topics. It is probable that they represent the grouping together of a very large number of experiments and problems in what seem their natural division, rather than the selection of a set of topics systematically designed to cover the desired field. In each chapter the arrangement of material is as follows: First, the principles involved are stated and illustrated by diagrams, and simple problems. In some cases commercial apparatus is used to illustrate the application of the principles. Then follows a summary of the principles and after this a series of practice problems concludes the chapter. This plan has several excellent features, of which the principal one is the large use made of problems. The connection between the principles and their application, as far as it goes, is good. It should, however, go farther. The review of fundamentals is excellent if it is not used to "cram" the memory but rather to serve as a summing up of the chapter.

Although in the preface the author states that "the text is confined to what is believed to be an adequate treatment of a *few* fundamental ideas rather than to a discursive treatment of *many*," it will occur to the reader to ask "if these are a few, what would many be?" Of course, it is difficult to determine just how far to go in the number of topics and in the extent of treatment of each. In view of the needs of the average industrial student it would apparently be the proper policy (1) to select for study such apparatus as he will meet in every-day life; (2) to teach him the electrical and magnetic laws underlying this; and (3) to show him the proper application of apparatus to industrial needs. On this basis the allotment of space mentioned above is disproportionate. For example, 32 pages are allowed for inductance and 32 for motors; 24 for electrical lighting and 24 for capacity; 35 for measurement of resistance and 39 for electrochemistry, etc. By "motors" and "generators" are here meant direct-current machines, alternating-current apparatus being only mentioned incidentally, although the latter is more likely to be used by the average student than the former.

A number of incidental inconsistencies which will, presumably, be eliminated in a later edition are apparent. A few of these will be noted. On page 82 a transformer is illustrated to show the use of cooling coils, although the student at this point has no idea what a transformer is. On page 220 a railway controller is shown, but its construction is not explained and the student knows no more about it after studying the figure than he did before. Either it should be made absolutely clear or it should be omitted. It was probably put in to give the page a practical appearance. On page 318 we find two good detail diagrams of motor starting boxes under the subject "capacity." They probably belong in the chapter on motors. On page 432 is a picture of a stout gentleman matching silk by "Moore vacuum light." This is interesting but its connection with the adjoining text on alternating-current impedance is hard to find. Fortunately these matters are not vital and they impart a slight touch of humor which does no great harm.

The reviewer knows from experience that it is not easy to write an elementary book on electricity. He believes that it is a most important field. A good book for industrial schools will do useful service and Mr. Timble's contribution is a step in the right direction. A very commendable feature is the reasonable price, which seems as low as could possibly be expected in view of the good mechanical work in the volume.

*Head Professor of Electrical Engineering, Cornell University, Ithaca, N. Y.

A Popular Book on Conservation.

THE CONSERVATION OF WATER.—By John L. Matheson. Author of "Re-Making the Mississippi," etc. Boston, Mass.: Small, Maynard & Co. Cloth; 5¼ x ¾ ins.; pp. 289; 32 text illustrations. $2, net; postage, 15 cts.

Inasmuch as all great reforms must be brought home to a considerable percentage of the people involved before they can be put into practical effect, popular discussions of the Conservation Movement are to be welcomed when presented with due consideration for both facts and reason. The book before us is decidedly popular in character and for the most part is sane. The author adopts some of the extreme and rather questionable views of the enthusiasts for Conservation, but, in general, he keeps fairly well within bounds. Some of the alleged facts and arguments seem to betray lack of knowledge of engineering principles and practices, but nothing of this sort which seems likely to do much harm has been noted in our reading of the book.

After dealing with water as a natural resource, the author takes up in succession floods and flood prevention, water storage, municipal supply and "The Purification of Rivers;" water power, swamp drainage, irrigation, soil conservation and navigation.

The book concludes with a general chapter entitled, "The Results of the Conservation of Water," in which there is certainly no lack of rosy enthusiasm. Favorite terms used by the author throughout are "water-farming" and "white coal" to represent, respectively, the devotion of land to water storage and the use of water for power, both of which the author strongly advocates.

A few well-chosen and particularly well-presented half-tone reproductions of photographs enliven the book and add the point in force to this argument.

SOCIAL INSURANCE.—Report by G. H. Knibbs, F. S. S., Commonwealth Statistician, Commonwealth Bureau of Census and Statistics, to the Honorable F. G. Tudor, M. P., Minister of State for Trade and Customs; September, 1910. Melbourne, Australia: Pub. Doc. Paper; 6 x 9¾ ins.; pp. 108; four appendixes.

In remarkably small compass, considering the scope of the subject, the author of this pamphlet has presented a review of social or workingmen's insurance in Germany, Austria, Hungary, Italy, Finland, Holland, Norway and France. This survey of actual practice in various European states is prefaced by an illuminating general discussion of "Modern Conceptions of Social Insurance." This discussion is notable for its brevity, its clearness and its sanity.

After the review of European practice as regards insurance against sickness, accident, invalidity and old age, the author presents in relatively brief compass "The Problem of Insurance Against Unemployment." He here points out the difficulties involved in scientific insurance against being out of work, due to the personal factors involved and the possible influence of labor unions. The relatively few attempts at unemployment insurance in Europe are noted.

Having disposed of social insurance practice in other countries and having discussed the general principles involved, the author devotes a few pages to existing institutions for social insurance in Australia, to a discussion of the benefits flowing from social insurance, and to a general survey and outlook over the Australian situation.

Although treating his subject in much less detail than the larger and more formal study of "Workingmen's Insurance in Europe" (reviewed in these pages on Dec. 15, 1910), Mr. Knibbs' contribution to the subject will be quite as useful to many, particularly to those who are short of time or who do not wish to follow out the subject in all its details.

Starting with the January, 1911, issue, "Cement Age," of New York, and "Concrete Engineering," of Cleveland, O., are to be conducted as one journal with the title "Cement Age with which is combined Concrete Engineering." The enlarged paper is still to be published as a monthly, by the Cement Age Co., from the old offices of that company at 30 Church St., New York City, under the editorial direction of Mr. Robert W. Lesley, the former editor of "Cement Age."

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SECURING EFICIENCY IN RAILROAD WORK.—A lecture delivered at Harvard, Nov. 16, 1910. By Harrington Emerson, 30 Church St., New York City. Pamphlet 5 x 8 ins.; pp. 38.

This pamphlet describes the work done by Mr. Emerson and his associates in introducing efficiency methods on the Atchison, Topeka & Santa Fe R. R., beginning in 1904.

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The Theory of Applications of the Gyroscope.

UEBER DIE THEORIE DES KREISELS.—By F. Klein und A. Sommerfeld. Heft IV.: Die Technischen Anwendungen der Kreiseltheorie. Für den Druck bearbeitet und ergänzt by Fritz Noether. Leipzig, Germany: B. G. Teubner. Paper; 6½ x 10 ins.; pp. 205; 30 illustrations in text. 8 marks; American price, $3.20.

The gyroscope undoubtedly is worth having a compendious treatise written on it. Multiplex rotary motion not only is interesting for its physical peculiarities and the complications of their mathematical interpretation, but also appears in many practical applications. Ships, fast-running vehicles of all kinds and rifle bullets are subject to gyroscopic action no less than the steering mechanism of the torpedo and the stabilizers of the latest crop of monorail cars. Hence the present treatise may appeal to many different interests. It handles its matter thoroughly, and yet is not indigestibly mathematical, as this phase of the subject was treated in earlier parts of the same work. Parts I. to III., 630 pages, dealt with the theory of the gyroscope and with applications in astronomic and geophysics. Part IV., the book under notice, covers the engineering applications, in 190 pages. There is first a preliminary general discussion of gyroscopic stabilization; this is followed by subdivisions on: Gyroscopic action in railway vehicles (11 pp.); Torpedo steering devices (12 pp.); the Schlick steadying apparatus for ships (51 pp.); the Gyroscopic compass (18 pp.); Stability of the bicycle (21 pp.); Apparent and true gyroscopic action in the De Laval steam turbine (15 pp.); and finally a chapter on miscellaneous applications, including gyroscopic action in side-wheel and turbine steamers, the gyroscopic horizon, the action of projectiles from rifled guns, etc. The discussion of each of these items shows a considerable degree of appreciation of the practical factors operating to modify the ideal actions. While there is, perhaps, nothing in this book that is strictly new, yet as a grouping of the separate applications and as a harmonious treatment, it must be classed as new; and in the correct practical sense maintained in all but a few spots it is distinctly original.

STEAM TURBINES: THEIR DESIGN AND CONSTRUCTION.—By Rankin Kennedy, Author of "Modern Engines and Prime Movers," "Electrical Installations," "Flying Machines," Etc., New York: The Macmillan Co. London: Whittaker & Co. Cloth; 5⅛ x 8¼ ins.; pp. 104; 62 illustrations in text. $1.25, net.

The author's scheme has been to first discuss the problems in physics and mechanics involved in the design of steam turbines. This is followed by descriptions of simple turbines and discussions of some of the actions. Next is a section on "Turbine Wheels in Series," describing later types and auxiliary apparatus like condensers and vacuum augmenters. Two chapters following show the calculations of main dimensions and the types of wheel construction which have been evolved.

The author has aimed at a brief presentation of turbine design for students and engineers inexperienced in this particular branch. He has not been remarkably successful, however, due in part to what would seem to American readers like a rather questionable selection of material. In part the trouble is found in involved and unintelligible expositions of which the opening paragraph of Chapter I. is a fair example.

NOTES ON IRRIGATION WORKS.—A Course of Lectures Delivered at Oxford under the Auspices of the Common University Fund. By N. F. Mackenzie, Hony. M. A. Oxon.; M. Inst. C. E. New York: D. Van Nostrand Co. Cloth; 5½ x 8¼ ins.; pp. 111; six plates (four folding) and eleven text figures. Price, $2.50, net.

The lectures here reprinted are a happy combination of technical and general information on some of the most important economic, political and engineering phases of irrigation. The lectures were originally delivered in the winter of 1909 before students of engineering and students of geography at Oxford University. Apparently the course was a limited one, so the author found it impossible to cover the whole field. He therefore concentrated his time upon a few topics, beginning with preliminary investigations, both statistical and engineering, necessary in formulating an engineering project. He next took up weirs. This subject was followed by a sketch of "the development of irrigation in Egypt since 1894." Next comes another technical subject, namely, the design of various kinds of irrigation channels. The author then closes with a review of "irrigation revenue and land revenue in India."

For the most part, the author confines himself to Indian and Egyptian practice. He makes numerous allusions, however, to American practice as well. The treatment is nowhere highly technical and is everywhere in pleasing literary form, and abounds with information of quite wide general interest. It may be read with pleasure and considerable information by students of irrigation in any part of the world who are not already familiar with the extensive treatises devoted more or less wholly to irrigation in Egypt and in India.

HOW TO PREPARE A PAPER FOR PUBLICATION.—Read at the Marine Biological Laboratory, Wood's Hole, Mass., July 5, 1910. By C. Bowyer Vaux. Baltimore, Md.: Williams & Wilkins Co. Paper; 7 x 10 ins.; pp. 20. Gratis.

The publishers of this little pamphlet are the printers for a number of the national engineering societies. They have printed this paper for free distribution as an aid to those who contribute to technical and scientific publications and to the proceedings of societies. The paper, however, relates more to the mechanical work in connection with printing and publishing than to the work done by the writer.

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Water Power for the Farmer.

WATER POWER FOR THE FARM AND COUNTRY HOME. By David R. Cooper, Engineer-Secretary, New York State Water Supply Commission. Albany, N. Y.: Pub. Doc. Paper; 7 × 10 ins.; pp. 45; illustrated.

We understand that this pamphlet has been prepared for general distribution in the agricultural districts of New York State. Therefore perhaps it is fair to examine it only as to its use to the farmer. This depends in a large measure on the success with which it fairly states the advantages which a farmer may secure and the limitations and difficulties under which each water-power development must be made. So far as the general impression of this pamphlet goes, the use of electric machinery will make the farmer's life more comfortable rather than increase his scanty dividends. The greatest benefit it would seem might come from lightening the drudgery of the farmer's household—a field where it has been often claimed the greatest need exists.

Doubtless there are hundreds of small streams in the state which should permit of the development of 1 to 5 HP. throughout the year, and it seems to be the aim of the author to awaken interest in the possibilities of these small developments rather than to show in specific detail how typical cases should be handled. On that account the predominance of expositions of benefits may be excused. If a farmer is keen enough to take up this study, he will not rush blindly into spending his small surplus and the cautions at the end of the pamphlet should properly put him on guard.

It is notable that many of the plants described are "model" or "picture" farms or places where the interested parties included some one with engineering or scientific training. What can be done by the general farmer not so aided remains to be demonstrated. Competent technical counsel on these tiny developments would be too expensive unless the farmers of a district were to club together to secure the services of an engineer—and at that one who had a partly altruistic motive.

In many plants described are ingenious makeshift devices used to eliminate the necessity of going to the station to start up the generator. These farmer-engineers seem to have believed that motor-driven, remote-control valves, etc., were too expensive or too complicated.

STORAGE BATTERY ENGINEERING.—A Practical Treatise for Engineers. By Lamar Lyndon. Third edition, rewritten and enlarged. New York and London: McGraw-Hill Book Co. Cloth; 6 × 9¼ ins.; pp. 601; four plates (three folding), 298 text illustrations and 19 tables. $4.00, net.

It is obvious that the general progress of electrical engineering, since the publication of the first edition of this book in 1903, must have been accompanied with changes and growth in what the author has been pleased to call "storage-battery engineering." Perhaps much of this growth is due to a better knowledge of the use of storage batteries, and for the spread of such knowledge the earlier editions of this book must be given much credit. In an appreciative review of this pioneer volume, in Engineering News, May 14, 1903, it was pointed out how the author had strictly adhered to the practical side. Looking back now, upon the field which that book had, the greatest criticism that can be made is perhaps that it too completely ignored the side of theoretical electro-chemistry. Evidently the author has come to feel that way for the present edition shows the addition of an introductory chapter on electrolytic dissociation and the voltaic couple. For similar reason, the chapter "Thermodynamic Theory of the Lead Cell," outlining the heat-conversion relations of electrolytic processes has been added. The more theoretical parts generally have been amplified; for instance, the few pages in the first edition on chemistry have been increased to a chapter on chemical theory. The stickler for practicalities however will find the present edition as useful to him as the first since such discussions may be slid over.

The other noticeable changes are those made necessary by the removal of a few types of lead plates and operating auxiliaries from the field. There is new matter on the application of storage

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M. Am. Soc. M. E., M. Soc. Prom. Eng. Educ. Author, "The Art of Roadmaking" Formerly Manager Engineering News Book Department

The ability to speak and write clearly and forcibly—to express his thoughts and understandings and to describe his works so that others will understand them—is one of the most valuable items in the equipment of the engineer, but this fact is often too little appreciated by the student, or by the engineer during his earlier training. Every engineer is, sooner or later, called on to discuss technical matters with clients, to present details and explanations of engineering subjects, both orally and in writing, before public gatherings, committees, and board of directors, consisting of non-technical men; and to prepare specifications and contracts, reports, descriptions of works, etc., in the course of their professional duties.

To assist practicing engineers, as well as students of engineering in dealing with the special difficulties of this class of literature, is the purpose of this book. The material is an elaboration of that given by the writer in addresses to engineering students during the early part of 1910, and its presentation in book form is an outgrowth of a request that this material might be given in a more permanent and useful form than in oral discourse. When its preparation was commenced the intention was to issue two or three pamphlets only, but as the work progressed, the idea developed that while there is considerable material in published form for the would-be writer of fiction and magazine stories, there is practically nothing, except in occasional articles and pamphlets, for the engineer-writer, and the present form of the work was therefore decided upon.

The book is not a set of rules for the teaching of English, Grammar, or Rhetoric, or any other of the fundamentals of literature, but rather an effort to point out the application of these fundamentals to the literary work and study of the engineer.

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batteries to the regulation of alternating-current systems as at Gary, Ill., and on the use of mercury arcs for converting alternating current to direct.

A Valuable Addition to Plumbing Literature

Reviewed by CHAS. B. BALL.*

STANDARD PRACTICAL PLUMBING.—An Exhaustive Treatise on All Branches of Plumbing Construction, Including Drainage and Venting, Ventilation, Hot and Cold Water Supply and Circulation. By R. M. Starbuck, Author of "Practical Wrinkles for the Plumber," "Modern Plumbing Illustrated." New York: The Norman W. Henley Publishing Co. Cloth; 6¼ × 9¼ ins.; pp. 406 + 20; 347 illustrations in text (specially drawn). $3.50, net.

The author has produced in this volume one of the best books, possibly the best, on modern plumbing yet written. The general scope of the work and arrangement of chapters is good, although it does not contain any connected description of the various materials used in a system of piping and fixtures. While it may fairly be admitted that the work shows the latest and best plumbing practice, the claim to be "an exhaustive treatise on all branches of plumbing construction" is hardly justified. The author's point of view is that of the trained craftsman rather than that of the educated engineer, and the work is in parts lacking in clear classification and definite analysis. Its style is in general well suited to a book of instructions to the progressive journeymen who will most benefit by reading it. The illustrations number 350 and are in the main well drawn and suited to their purpose.

The author appears to be ignorant of the unfortunate fact that earthenware pipes are still allowed under buildings in a number of large cities, and should therefore modify his statement on page 101, which fails to specify certain noteworthy exceptions, like Chicago and Milwaukee, to the requirement of cast-iron in such locations. As to the size of drains, he well says "It is true that it is almost as serious a matter to use too large pipe for horizontal drains and sewers as to use too small pipe," an opinion rarely held among plumbers.

Although the practice of venting the upper water closet is disapproved in the text, page 89, various illustrations, as Figs. 110, 113, 193, 194, show this water closet provided with a back vent, contrary to the practice recognized for some years past by the best authorities. Also, Figs. 214, 215 show back vents for horse-stall floor drains located close to vertical soil stacks extended through the roof.

In upholding the substitution of other materials for lead pipes and traps, page 122, and in his advocacy of still further limiting its use, the author shows commendable courage and openness of mind, but this candor is offset by his indeterminate discussion in Chapter XII. of the use of a main trap on the drain. The proposal to ventilate main sewer systems by large ventilating stacks has been proven not to be a possibility on a large scale, and the claim that "It is very seldom that a main trap becomes stopped up" is at variance with the experience of most plumbers.

The chapter which treats of water closets is an excellent one, complete and thorough in classification and in its description of the operation of the different types of such fixtures. The references to page 161, Figs. 127 and 128, as having an S trap below the closets, are slips that should be corrected, as is the statement that "The use of pan water closets is now everywhere prohibited." It is sad but true that pan water closets are still sold and installed in backward localities in the United States. Fig. 157 is incorrect, as the closet bowl shown is not an offset water closet, as its title states.

The discussion of traps in Chapter V. is complete and discriminating, especially so in respect to the value of the common forms of traps. The qualities which the ideal trap possesses and the methods by which a trap seal can be lost are well set out. The statement that "a stoppoge of the trap vent is to be considered more dangerous than a stoppage of the water" is hardly reconcilable with the author's previous assertion that "it will not be a matter of great surprise to see within the next few years, the plumbing system installed for the use of trap vents." The author also says: "When this result [the disuse of trap vents] comes, the decrease in the complex form and in the cost of the plumbing system will be very great. Such a system, however, will not be acceptable until the problems involved shall have been solved beyond a question of doubt." Since the need of venting traps depends upon well-determined laws governing the constitution of matter and the operation of natural forces, the author's opinion seems to be over sanguine.

In treating of continuous vents, a subject effectively presented, pages 96-100, the author would still further strengthen his argument by a full statement, not now introduced, of the disadvantages of a floor connection as compared with a wall connection, for a waste.

In respect to the use of bell traps on floor drains, it appears that the writer's claim that "It is very customary to use drain having a bell trap" is an over-statement, as the defects of the bell trap have been well known and widely published for a long time past. If they are now used it can only be in benighted neighborhoods where the light of modern sanitary progress has not penetrated.

The general commendation given to the special forms of cast-iron fittings because of the saving of labor in installation, the reduction of the number of joints and the compact arrangement made possible by their use, appears to result in over emphasis of the advantages gained, especially when applied to a monstrosity like the Kelly octopus, which is described as "an especially clever fitting."

Such inaccuracies as have been noted do not, however, constitute a considerable portion of the book, or, indeed, very seriously detract from its value to uncritical readers. Even with these faults, which are readily subject to correction in a second edition, the volume constitutes one of the most valuable contributions yet made to a subject, the literature of which is still fragmentary and incomplete.

*Chief Sanitary Inspector, Department of Health, 215 Madison St., Chicago, Ill.

BACKBONE OF PERSPECTIVE.—By T. U. Taylor, C. E., University of Virginia; M. C. E., Cornell University; Professor of Civil Engineering, University of Texas; M. Am. Soc. C. E. Chicago, Ill.: The Myron C. Clark Publishing Co. Cloth; 4½ × 7¼ ins.; pp. 56; 40 text illustrations. $1, net.

In the first part of this little book Prof. Taylor gives a handy statement of the principles and practice of the graphical construction of perspective projection. His language and method of demonstration are clear. The important matter of locating the vanishing-point of a system of parallel lines is unfortunately somewhat obscured by stating the rule so as to locate the vanishing-point on the horizon (which is true for horizontal lines only); but the attentive reader will not be misled, and the author humorously remarks in his preface:

A reader that finds no errors in these pages should read again.

Parallel projection along an inclined axis is called by Prof. Taylor "axometric" projection; the usual term, we believe, is axonometric, but the shortening does not seem objectionable. In this section we miss direct formulas for the relation between scale ratios and angles of axes. Such formulas are not complicated, and they are the first thing that the practical reader would look for. A table of possible scale ratios, with angles of axes, would add to the value of the chapter; but this perhaps is to be looked for in a handbook rather than in a text.

A third chapter, Shades and Shadows, gives the Descriptive Geometry of this subject.

JOURNAL OF THE AMERICAN PUBLIC HEALTH ASSOCIATION, Continuing the American Journal of Public Hygiene. Vol I. (Old Series, Vol. VII.), No. 1. Columbus, Ohio: B. R. Rickards, Managing Editor. Paper; 6½ x 10 ins.; pp. 76. Price per year, $3; single copies, for members, 20 cts., for non-members, 30 cts.

The lack of an adequate American public-health journal has long been felt by many sanitarians and public-health officers. The need was partly met some years ago by the establishment of a quarterly, devoted in the first instance to the Association of Massachusetts Boards of Health, and later first to one of the sections of, finally to the whole of the American Public Health Association. Besides being the official organ of the two associations noted, the American Journal of Public Hygiene, as it was called after its enlargement, contained both editorial matter and brief abstracts of sanitary and hygienic articles published elsewhere.

The journal now before us in its first number will appear monthly. It will contain other reports or abstracts of the papers presented before the American Public Health Association and its sections devoted to health laboratory work, vital statistics and health officers. It will also contain papers and reports from organizations more or less closely affiliated with the American Public Health Association, together with special editorials, articles and abstracts. A review department, to deal with current literature, will also be included. In the announcement of the "Committee on Journal" it is stated:

The Journal should also constitute the medium for the exchange of experiences and methods between the health officers of the entire country. Discussions of questions of administration, office forms and methods, finance and kindred matters can be made enormously useful to all.

The Journal in its new form has a possible wide field of usefulness, and as it is to be conducted in the future, as it has been in the past, by Mr. B. R. Rickards, as Managing Editor, presumably with the support of Mr. H. W. Hill and others who have been associated with the Journal in its earlier form, there is every reason to expect that these possibilities will be realized.

READINGS IN CIVIL GOVERNMENT.—By Percy Lewis Kaye, Ph. D., Head of the Department of History in the Baltimore City College. New York: The Century Co. Cloth; 5¼ × 7¾ ins.; pp. 535. $1.20, net.

Under three main heads, the Spirit, the Form and the Functions of government, the author has put together a large collection of varied but, on the whole, closely related writings which together cover practically every important branch and phase of civil government. After a number of selections setting forth "The Principles of Government in General," the occasional addresses, magazine articles and citations from books, of which the volume is composed, take up in succession the Constitution of the United States, relations between state and federal governments and individual and political rights and duties. This completes the section on the "Spirit of American Government." Under "Form of American Government" the various branches and departments of both national, state and municipal governments are taken up. Here also is a section on "Party Organization." Under "Functions of Government" the excerpts deal with the freedom of the individual, taxation, finance, currency and banking, interstate commerce and, finally, elections.

Although the volume was intended primarily for use in secondary schools it may be read profitably by anyone who wishes to review the essential principles and current practices of national, state and municipal government. Contrasting views are presented, and useful references for further reading are given.

OPEN SPECIFICATIONS.—For Waterproof Macadam Roadways, Asphaltic Concrete Pavement, Brick and Block Pavement Filler, Sheet Asphalt Pavement, Asphalt Mastic Floors, Coating Steel Pipe, Waterproofing Reservoirs. Chicago, Ill.: The American Asphaltum & Rubber Co. Stiff paper; 6 × 9 ins.; pp. 18. Gratis.

While, doubtless, the primary object of the publication of these specifications was to stimulate trade, yet they merit attention from all interested in the use of asphaltic cements used for pavements and for some other forms of asphalt used in engineering work. The company publishing the specifications states:

In the preparation of these specifications for the use of asphalt and various asphaltic materials, Mr. H. B. Pullar, Manager of our Plants and Laboratory, has been governed by the desire to help rather than hinder all well directed effort. Obviously this desire could not be faithfully carried out if specifications were loosely drafted, so as to admit any material, the value of which has not been clearly established.

We have omitted all reference to ductility, as limitations in this respect cannot be positively stated for the reason that equally good results have been obtained from asphalts of high ductility, low ductility and those of practically no ductility.

A POCKET-BOOK OF MECHANICAL ENGINEERING.—Tables, Data, Formulas, Theory and Examples.' For beginners and students. By Charles M. Sames, B. Sc., Mechanical Engineer. Fourth edition, revised and enlarged. Jersey City, N. J.: The Author. Leather; 4¼ x 6½ ins.; pp. 218; 42 illustrations in text. $2, net.

The successive editions of Mr. Sames manual of extremely condensed data have shown a small increase in number of pages. This has been the result of embodying in appendices such new matter as the compiler has judged useful. It is evident, therefore, that any one who uses this last edition should make three searches for data or information needed—one in the main text, one in Appendix A and one in Appendix B. This is not difficult since the sequence of topics in the appendices is that of the main text, but the need for searching the appendices as well as the text is apt to be often overlooked. The demand for this true "pocket-book," resulting in four editions, seems a better comment on its utility than any summary that might be made here of the contents.

The "Railway Electrical Engineer," official journal of the Association of Railway Electrical Engineers, has been consolidated with the "Electric Trunk Line Age," a small paper issued by Muralt & Co., Engineer, of New York City. Mr. C. L. de Muralt will be editor and the journal will retain the name first noted.

Publications Received.

ACADEMIC AND INDUSTRIAL EFFICIENCY.—A Report to The Carnegie Foundation for the Advancement of Teaching. By Morris Llewellyn Cooke, M. E.; M. Am. Soc. M. E. New York: The Carnegie Foundation. Paper; 7¼ x 10 ins.; pp. 134; eleven tables; appendix.

AMERICAN NEWSPAPER ANNUAL AND DIRECTORY, 1911.—A Catalog of American Newspapers, [and] a Description of Every Place in the United States and Canada in Which a Newspaper is Published. Philadelphia, Pa.: N. W. Ayer & Son. Cloth; 6¾ x 10 ins.; pp. 1,418; maps. $5, net.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Proceedings of the 17th Annual Convention Held at Erie, Pa., Oct. 11-14, 1910. (A. Prescott Folwell, Secy., 239 West 39th St., New York City). Cloth; 6 x 9 ins.; pp. 452; illustrated.

THE AMERICAN YEAR BOOK.—A Record of Events and Progress, 1910. Edited by S. N. D. North, L. L. D., under direction of a Supervisory Board representing national learned societies. New York and London: D. Appleton & Co. Cloth; 5¼ x 8 ins.; pp. 867. $3.50, net.

ARTS-CRAFTS LAMPS.—How to Make Them. By John D. Adams. Chicago, Ill.: Popular Mechanics Co. Cloth; 4¾ x 7 ins.; pp. 87; illustrated. 25 cts., net.

ASSOCIATION OF TRANSPORTATION AND CAR ACCOUNTING OFFICERS.—Proceedings of the meeting held at the Auditorium Hotel, Chicago, Ill., Dec. 13-14, 1910, (G. P. Conrad, Secy., 24 Park Place, New York City). Paper; 5¾ x 8½ ins.; pp. 148.

BOARD OF RAILROAD COMMISSIONERS (IOWA).—Thirty-Second Annual Report, Dec. 7, 1909. (Dwight N. Lewis, Secy.) Des Moines, Ia.: Pub. Doc. Cloth; 6½ x 9 ins.; pp. 711.

BUILDING CONSTRUCTION.—By Beresford Pite, F. R. I. B. A., Professor of Architecture, College of Art; Frank T. Baggallay, F. R. I. B. A.; H. D. Searles-Wood, F. R. I. B. A., and E. Sprague, Assoc. M. Inst. C. E. Edited by F. M. Simpson, F. R. I. B. A., Professor of Architecture in the University of London. In two volumes. Vol. I. New York and London: Longmans, Green & Co. Cloth; 5¾ x 9¼ ins.; pp. 452; 249 text illustrations. $5, net; English price, 18s., net.

BUILDING PROGRESS.—Vol I., No. I., January, 1911.—Sherman Ford, Editor. Pittsburg, Pa.: National Fire Proofing Co. Paper; 6¾ x 9¾ ins.; pp. 31; illustrated. 10 cts. per copy; $1 yearly in advance.

BUREAU OF FORESTRY, MANILA, P. I.—Report of the Director (Major George P. Ahern) for the Period July 1, 1909-June 30, 1910. Manila, P. I.: Pub. Doc. Paper; 6 x 9 ins.; pp. 25.

DEUTSCHE INDUSTRIE-DEUTSCHE KULTUR.—Telefunken-Nummer. Berlin: Ecksteins Biographischer Verlag. Paper; 9 x 11¼ ins.; pp. 79; 68 text illustrations and 19 views of stations.

DISPOSAL AND PURIFICATION OF FACTORY WASTES OR MANUFACTURING SEWAGE.—By H. W. Clark, Chemist to the Massachusetts State Board of Health. Reprinted from the 41st Annual Report of the Massachusetts State Board of Health. Boston, Mass.: Pub. Doc. Paper; 5¾ x 9 ins.; pp. 67.

ELECTRIC RAILWAY TRANSPORTATION.—The Annals of the American Academy of Political and Social Science, 1911. Vol XXXVII. Emory R. Johnson, Editor. Philadelphia, Pa.: The Academy. Paper; 7 x 10 ins.; pp. 244; illustrated. $6 per year; $1 per copy.

AN ELEMENTARY MANUAL OF STATISTICS.—By Arthur L. Bowley, M. A., F. S. S.; Reader in Statistics in the University of London; Author of "Elements of Statistics," "National Progress Since 1882," Etc. London: Macdonald & Evans. Cloth, 5½ x 8¾ ins.; pp. 215; six diagrams in text. 5s., net.

ELEMENTARY PRACTICAL MECHANICS.—By J. M. Jameson, Head of the Department of Physics, School of Science and Technology, Pratt Institute, Brooklyn, N. Y. Second edition. New York and London: Longmans, Green & Co. Cloth; 5 x 7½ ins.; pp. 321; 212 illustrations in text. $1.60, net.

THE ELEMENTS OF GRAPHIC STATICS AND OF GENERAL GRAPHIC METHODS.—By William Ledyard Cathcart, M. Am. Soc. Naval En., Soc. of Naval

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Diagrams for Designing Reinforced Concrete Structures.
Including Diagrams for Reactions and Strengths of Steel Beams, by G. F. Dodge, M. West. Soc. Engrs. 13 x 15½ inches; 104 pages. Postpaid, $4.00.

Cost of Electric Transmission Lines.
(Both Conduits and Pole Lines)
The title of this book, by Clarence Mayer, is "Telephone Construction-Methods and Cost," which is somewhat a misnomer in that it does not indicate its wide scope. It is 6 x 9 ins.; 300 pages. Postpaid, $4.00.

Engineers' Pocketbook of Reinforced Concrete.
By E. Lee Heidenreich. "Mr. Heidenreich's pocketbook is nearer the ideal than any on the same subject heretofore published."—Engineering News, Jan. 14, 1909. Leather; 4½ x 6¾ ins.; 374 pages. Postpaid, $3.00.

The Reinforced Concrete Pocketbook.
By L. J. Mensch, M. Am. Soc. C. E. A book by an experienced engineer and successful contractor. Leather; 4¼ x 6¼ ins.; 216 pages. Postpaid, $4.00.

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(Both Railway and Highway.)
By H. Grattan Tyrrell. Leather; 4½ x 6¾ ins.; 272 pages. Postpaid, $3.00.

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By Edward Godfrey. Leather; 4 x 6½ ins.; 218 pages. Postpaid, $2.50.

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By DELOS F. WILCOX, Ph.D.

Chief of the Bureau of Franchises, Public Service Commission, First District of New York

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